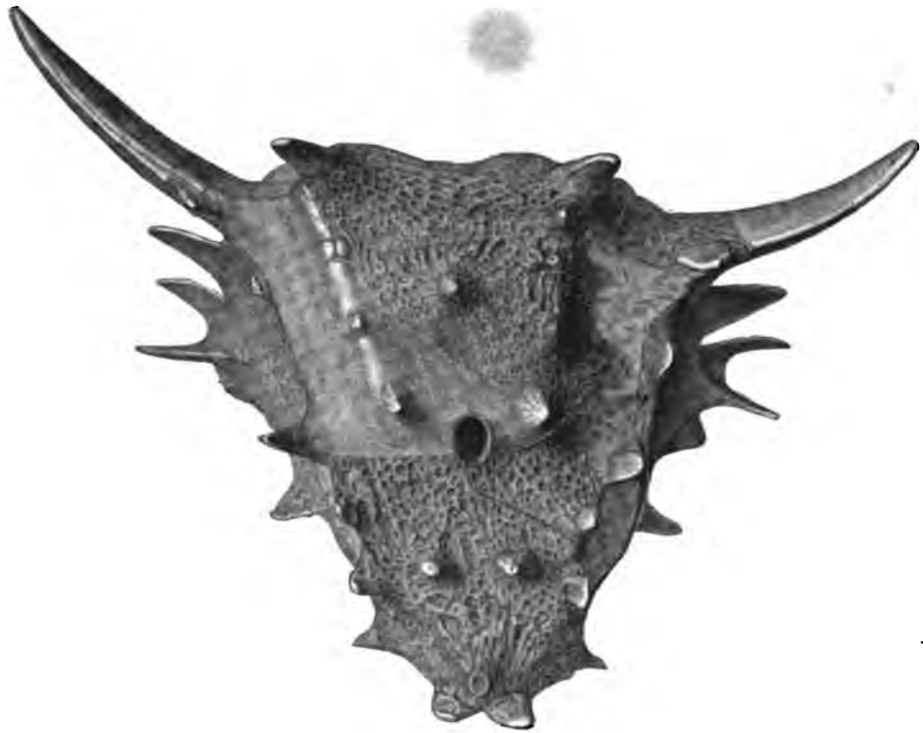
ANNALS OF BRITISH GEOLOGY,

1893.



Upper surface of Head of *Elginia mirabilis*, Newton. $\frac{4}{7}$ nat. size.

Page 154.

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A Digest of the Books and Papers [illegible]
during the Year;

WITH AN INTRODUCTION [illegible]

BY

J. F. BLAKE, M.A., F.G.S.

WITH NINETY ILLUSTRATIONS.

LONDON:
DULAU & CO., 37, SOHO SQUARE, W.

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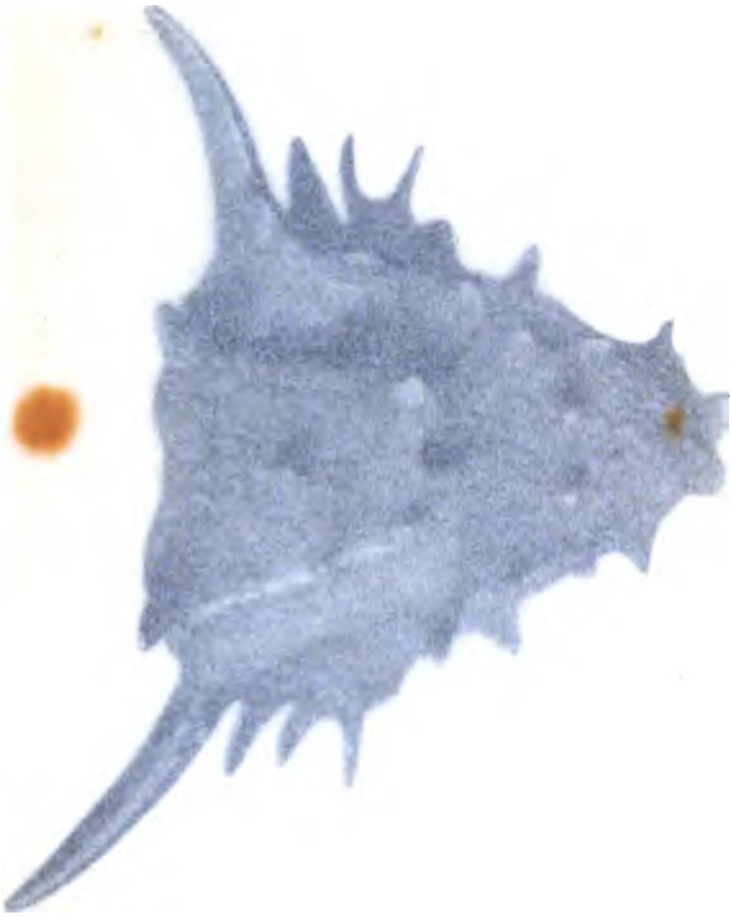

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HERTFORD:
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PREFACE.

NO change of method has been introduced into this fourth volume, with the exception of the greater brevity of the notices of publications of a text-book nature. Of these only the principle characters are indicated, and detailed criticisms are avoided. I regret to find that in some quarters even the Introductory Review is objected to: so far as these objections, however, have reached me, they come from those who would gain by authority being substituted for discussion, and who resent being brought down into the dusty arena of scientific contention. I rejoice to find that they in no case come from those younger geologists whose equal capacity and better training make it somewhat difficult for their self-instructed elders to come within speaking distance of them. It is to them that the future of the science and of such a book as this belongs.

On my part also I have something to resent. To call this book a compilation, as has been done, is to do it an injustice. It is as pure a piece of original research as I have ever been guilty of, and much harder than many. It is true that it is not in itself "geology" or a study of the earth, but it is a study of the science of geology. In just the same way, to be a student of anthropology is not the same thing as being a father. To compile a work is to make statements borrowed from others without having personal knowledge of them. In

the present case, the question is—"What have geologists written during the year?" and "How far have they advanced the science?" To ascertain this from one's own knowledge, one must go to the writings themselves, read, digest, and understand them; and this, as far as I am capable of it, has been done. No borrowed statements whatever are inserted.

I have again to thank the many authors who have revised the abstracts which I have sent them; the very few alterations which they have been led to make give me confidence that where the abstracts have not been revised they are not very far from correct. I have also to specially thank Mr. C. Davies Sherborn for kindly looking over the proofs of sheets which I have been obliged to leave untouched.

In the matter of illustrations, I have again to thank the Council of the Geological Society and the respective authors for permission to have electros for figures; Dr. H. Woodward for the loan of the blocks for figs. 14, 20, 21; and Mr. E. T. Newton, Dr. J. W. Gregory, and Mr. A. Smith Woodward for copies of the plates from which figs. 9–13 and 17 have been produced.

I am glad to find that the support of the work is gradually, though slowly, increasing, and to anticipate that the present volume will be approximately self-supporting, in which case it is probable that it will be followed by at least another.

J. F. BLAKE.

December 11, 1894.

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ANNALS OF BRITISH GEOLOGY, 1893.

INTRODUCTORY REVIEW

IN the year 1893 the number of geological contributions has been greatly increased, and is the largest that has yet been dealt with. In the years 1890, 1891, 1892, there were respectively 585, 630, and 550, but in the year now dealt with there are 730. The number of authors has not, however, increased in the same proportion, rising only to 360, which is still below the number in 1891. This result is partly due to the greater completeness of the "Annals" itself, sources of publication having been discovered which were before unknown; but in most cases these sources have contained nothing belonging to the past years. Neither has the bulk and weight of the matter increased in proportion to the number, as may be seen by the fact that though the abstracts have been made on the same principles throughout, the number of pages has not increased proportionally. An analysis of the different branches shows that the increase has chiefly taken place in General Geology, Economics, and Foreign Geology; the last particularly number 50 per cent. above any previous year, and the first as much above the average.

Another new periodical has started during the year, devoted to the Glacial Geology, called "The Glacialists' Magazine." It is the organ of the Glacialists' Association, and is edited by its Secretary, Mr. P. F. Kendall. Its supporters belong to what is called the New School in that subject, but its contributors are sought from amongst the supporters of both

schools, the object being to give a fair hearing to all sides. It is published monthly by F. H. Butler, of Brompton Road, and each number contains about twenty pages, some of which are devoted to "current glacial bibliography." The price is 6*d*.

Another new periodical may be noticed which started in 1892: "The Annals of Scottish Natural History." It takes the place of the "Scottish Naturalist," and contains occasional papers on geology.

GENERAL GEOLOGY.

UNDERGROUND TEMPERATURE.—Three series of observations are recorded. They show remarkable variations. One in America gives an increasing rate of rise for every stage in descent, so that while the rise is 1° in 92 ft. at first, it is as much as 1° in 58 ft. at the bottom. Another series, however, in Alsatia points to the increase being in some cases due to local circumstances, particularly where petroleum is found, so that one must be very cautious in assuming any well-defined law of increase.

THE ORIGIN OF LAKES.—Some considerable discussion has taken place on this subject, the main question being the oft disputed one, whether most or any lakes, especially in mountain districts, are due to glacial erosion; and for the most part the well-known arguments are adduced on either side. Lakes are doubtless due to many causes, and if a glacier, or perhaps we ought to say an ice-sheet, can erode a rock basin, this may well be one of the rarest of those causes. In any particular case, such as those of the Alps, where the question must be decided by the local phenomena, it cannot count for nothing that Prof. Bonney, than whom no one is better acquainted with glaciers and their work, is distinctly opposed to the glacial origin of these lakes, whereas his opponents are not known to be familiar with glacier work at all, and that those who are familiar with the Himalayan glaciers side with the former. It would certainly require a very robust faith for anyone to see the lakes of Como and Lugano, the bottoms of which are below sea-level, and believe in their glacial origin. The old argument that lakes abound in mountain regions which have been glaciated

and not in those which have escaped glaciation seems completely met by the old reply, that glaciers preserve lakes when formed, but do not originate them. With minor lakes and tarns the case is different. They are so abundantly scattered over some countries, such as Scandinavia, that upheavals are out of the question, and the only common feature of such countries compared with those which have no lakes seems to be that they alone have been glaciated by moving ice. The only argument that appears to be new is, that some lakes have their tributaries running into them at right angles and not at the ends of side valleys, from which it seems to be inferred that the main valley has been excavated by some agent which could not touch the side valleys, and this is assumed to be the moving ice. The peculiarity would perhaps be better accounted for by the tributaries running in comparatively modern courses, indicating changes of surface-level since the main valley was formed.

SUBTERRANEAN EROSION.—This subject has been taken up by various Geologists. It is not, of course, chemical erosion that is referred to, which is well known to all; but the carrying away of particles of sand by water flowing underground. Prof. Lebour quotes some remarkable instances of strata dipping towards local valleys, and of swallow holes in insoluble strata which seem best explained in this way. Certainly, in pumping water from a bore-hole, sand *is* carried out of the strata underground, until the disturbed equilibrium is restored. So that underground denudation of this sort may well keep pace with the neighbouring surface denudation, though it would come to an end in time if the surface remained unaltered.

EARTHQUAKES IN BRITAIN.—This country used to be considered a quiet one, but we can scarcely call it so when sixteen earthquakes are recorded in the course of the year. These records are of interest as apparently indicating two distinct classes of earthquakes. In the case of Loch Broom and South-west Cornwall, Mr. Davison (**40**) gives definite boundaries to the "disturbed area," so the earthquakes were strictly local; whereas the August earthquake, which he records in Pembrokeshire only, but to which he assigns no boundaries, is traced by Prof. Hull (**42**) right across land and sea from Lough Foyle to

Cornwall, and is even thought by him to be connected in some way by the eruption of Etna, and to be related to some axial line. The centre of disturbance does not, however, appear to have been determined, and this line is no doubt only one of easy propagation, and not of original disturbance. In the same way Mr. Horne (**44**) refers an earthquake which was propagated to Ardnamurchan and to Edinburgh, and did most damage at Fortwilliam, to a disturbance at Loch Ness. Prof. Hull's suggestion that the time of the shock may have had some dependence on the moon, though somewhat pooh-poohed at Manchester, has the general support of Prof. J. Milne (**38**), and is not inconsistent with the production of earth-tides by our satellite.

EARTH MOVEMENTS.—Another subject of discussion also comes over from previous years, viz. that of the origin of mountain elevations. Mr. Mellard Reade (**52**) claims that it is finally settled that mountain areas are those of maximum original sedimentation; and this is so far incontrovertible that a mountain cannot be made out of nothing, so that there *must* have been a great amount of sediment in an area which includes the mountain range. It must not be forgotten, however, that in mountains we can see the thickness, but in plains it can only be discovered by boring; while Dutton's theory requires just the opposite to be the fact. Taking also minor examples, the axis of the Pennine Chain is not that of greatest deposition, which is in the Pendle Hills, by the side, while the Trias with 5000 ft. of strata occupies practically a plain. So far, however, as the two areas are coincident, the excess of sediment may be a contributing cause, for if from any external cause the hollow in which it was laid down was levelled up, the thickest mass would necessarily rise the highest. But that this can be the primary cause seems negatived, first, by Mr. Fisher's proof (**51**) that the rise of the isogeotherms, making every allowance, would be quite inadequate; and secondly, by the elevation of mountain chains in several stages. If this elevation be always due to the bulk of the sediment, surely the last place where a new maximum should occur would be on the top of the old one.

Allied to this question is that of the permanence of ocean basins, on which we have a contribution from the pen of the

veteran Prof. E. Suess (**56**). He is against their permanence, and his arguments undoubtedly tried to define more strictly the meaning of the words employed. If the ocean basins are due to sagging down of portions of the earth's crust, owing to the contraction of the radius, he points out that it does not follow that on further contraction they will be any deeper, unless there is more water to fill up the depression; only the land would relatively rise by the water sinking to a lower level. When also folds are produced, the rising limb which forms the mountain range will correspond to a sinking limb which makes an ocean depth. Thus the *details* of the oceans are not permanent. He cites also interesting facts showing how much continental areas have varied, and are varying still. Hence the permanence of ocean basins cannot involve the permanence of continental areas. After all, however, there is nothing in this to show that what is now an ocean basin has ever been a continental area.

FAULTS.—We have this year a most instructive paper by Mr. J. A. Church (**78**) on faults and their causes, which should be well considered. We have read in our text-books of the dying out of faults, but "the length of a fault" is a term, I think, not to be found in any, and hence their distinction into long and short ones is never made. Diagrams are usually drawn *across* faults, and no thought seems to be given as to what happens along their length. Thus they become a sort of Deus ex machinâ to help stratigraphists out of their difficulties. I have seen drawn in a recent paper an isolated short fault not 200 yards long, supposed to have some appreciable effect quite close up to its ending! Dealing with the causes, he points out that short faults must have some very local origin, and that in some cases the displacement is due to rocks on the two sides of a crack taking different forms, when both are forced to become curved by the approximation under pressure of the two ends of the fault. This condition happens to be admirably illustrated this year in No. **117**: *see* Fig. 4.

STRATIGRAPHICAL GEOLOGY.

CAMBRIAN.—I claim to have definitely proved in No. **113** that there is nothing "pre-Cambrian" in the district on either

side of Llyn Padarn, where the felsite has been of late years inserted as such on maps; that is, using the term as usually now understood, though if the name Cambrian be rightly restricted the whole of the Penrhyn Slates and the associated strata below are really pre-Cambrian. The proof that the great conglomerate and its associated grits lie unconformably on the purple slates, is no doubt difficult to follow for anyone not intimately acquainted with the ground; but of this I feel sure, that as such acquaintance is increased, in like proportion will the proofs seem to become more and more irresistible. A paper has since been written in the attempt to controvert them, with the result that the difficulties of the contrary view become all the more evident.

THE OLENELLUS ZONE. — Without having seen my note in No. **115**, Mr. Jules Marcou has written to me making the independent observation that the true precursor of *Paradoxides* is *Holmia*, which ought to be separated generically from *Ellipsocephalus*, *i.e.* from the later named *Olenellus*, which is nowhere known in America to actually underlie *Paradoxides*-bearing beds.

RADIOLARIAN CHERTS.—These have become of increasing importance now that a new locality in Cornwall has been discovered (**118**, **119**), and the old locality in the uplands of Scotland has been more fully described (**120**). In the latter case they are of Arenig age, and in both they are associated with basic lavas. What is the age of those of Cornwall is left undecided by their discoverers, Messrs. Fox and Teall, and this occurrence under similar conditions of surroundings renders it rather more doubtful whether age has anything to do with it. Nevertheless, very little is really known of these Cornish slates, and it would be very interesting if the unconformity at the base of the Arenig could be proved so far to the south.

THE DEVONIAN ROCKS OF NORTH DEVON. — Geologists will watch with great interest the development of Dr. Hicks' views on the stratigraphy of this district (**123**). According to his diagram (*see* Fig. 5), cleavage planes have been mistaken for bedding, and the true beds are undulating horizontally. If they continue to do so up to their junction with the Morte slates, the latter must necessarily be separated by a fault,

and the proof of their superior position must fall through. Doubtless Geologists will not forsake their old beliefs, till fossil evidence is definitely brought forward. Meanwhile it is reported that Dr. Hicks has obtained a graptolite from the Morte slates, which if proved correct should settle the question.

THE TRIAS AND PERMIAN. — Special attention may be drawn to Mr. Goodchild's account of these in Cumberland and Westmoreland (**145**). According to this there is a certain amount of unconformity here between the rocks referred to the two systems respectively, but notwithstanding this the author does not seem disposed to draw any very marked line between them. It is very much the same thing as occurs at the southern end of the eastern representatives of these rocks. (See the remarks last year.)

In Devonshire there is now a general conformity of opinion, as Dr. Irving on further examination (**148**) is content to place the Labyrinthodont beds in the Keuper. In Warwickshire we now have definite proof of the marine origin of the Upper Keuper Sandstone at least, by the occurrence in them of marine mollusca (**383**).

THE INFERIOR OOLITE SUBDIVISIONS. — Mr. Buckman's paper on this subject (**153**) provides much food for thought. We are told that we must recognize the periods of culmination of 12 distinct species of Ammonites as of sufficient importance to call those periods "hemeræ," and name them respectively after those species, and the proofs are given in this paper. No doubt a worker in the field gains a sort of feeling of what is important which a mere reader cannot attain, yet if a paper is to be of any use, beyond inciting readers to visit the country, it must carry conviction with it. Now there are 58 species of Ammonites named, and it does not appear why we should take more interest in the culmination of a selected 12 of these rather than of the other 46. If, however, they are indices of definite minuter periods of time, their number will of course equal the number of separate periods that can be recognized, and they should be the most widely spread of the fossils of the period. If, however, we take the named Ammonites in order, No. 1 or *Fusca* is only mentioned once, and there it is only proved to be above No. 8, while No. 2 or

Zigzag is not mentioned in any section: we may take it, therefore, that these two hemeræ are only inserted in the list for the sake of symmetry, and the proof of them is not here presented. No. 3 or *Truellei* is only mentioned twice, once as lying above No. 4, and once as in beds to which Nos. 3 and 4 are bracketed. This, therefore, does not seem very clearly marked off, especially as the same genus, *Strigoceras*, is recorded from the hemera No. 6. Again, No. 5 or *Niortensis* is only mentioned three times: in one of these it is the only ammonite recorded; in the second no ammonite is recorded above it, and the next below are Nos. 7 and 8 bracketed; and in the third it is recorded in a bed bracketed to No. 4, and the next below is No. 8. Next, No. 7 or *Sauzei* is only mentioned three times: in the first it is only shown to lie above No. 10, and in the other two it is in beds bracketed to Nos. 7 and 8. Then No. 9 is only mentioned once, where it is lower down in a single bed with Nos. 7 and 8. Lastly, No. 11, *Bradfordense*, is only mentioned three times: in one of these there is only an inch of sediment to contain this large fossil, in the second it is in a bed bracketed to No. 12, and in the third it lies above No. 12 only. A *reader* will scarcely find in these observations sufficient distinctness to convince him of the necessity of separating these hemeræ, and when these are gone there are only five left. The two bottom ones are characterized by *Liocerata*, amongst which *Murchisonæ* and *concavum* seem well separated; the next is characterized by *Witchelliæ*; the next by *Stephanocerata*; and the top one by *Parkinsoniæ*. Thus the old "zones" come out well, they can be easily seized, and it is to be feared that if these hemeræ are substituted for them, we may lose the broader facts by over-specialization. After all, however, it must be confessed that this is only the remark of a mere reader of the paper, and there may be more justification in nature for these subdivisions than appears from the data supplied by the Ammonites alone. For example, there certainly appears to be a well-marked horizon for *Rhynchonella ringens*.

Chalk Residues.—Special attention should be drawn to the valuable paper by Mr. Hume on this subject (**163**). The silicification of calcareous organisms is well shown by fora-

minifera occurring, sometimes in abundance, in the residue after treating with hydrochloric acid. The variety of extraneous minerals, many characteristic of igneous rocks, invites comparison with modern oceanic deposits. The progressive purity as we reach the summit of the chalk is well marked, and the variation in the amount of residue seems to indicate that the deposit was not independent of local conditions.

THE AGE OF FLINTS.—Some discussion has been raised (**166–168**) as to the time when flints were formed, *i.e.* whether it was while the chalk was still soft like ooze, or after it had been elevated and consolidated into a rock. When the flint is in the form of a vein, along a well-marked crack, such as is the case near Margate, the latter date must necessarily be the true one. But there seems to be no reason why it should not have begun at an earlier date. So much of the flint as can be obtained from the organism which it encloses would begin to form at once, for all the conditions are present, and nature never waits; but when the siliceous material has *travelled* it must have had a carrier. In saturated ooze the water is stagnant and cannot well act as such, so that the finishing off of large flints seems to require a previous elevation of the rock. If this be so the flints, unless all the disseminated silica has been exhausted, which is not always the case (*see* No. **164**), must still be increasing in size.

NODULES IN BOULDER-CLAY.—Some curious nodules are described by Mr. Watts in the Boulder-clay of Piethorn Valley, which was exactly like one that was obtained some years ago in the same formation in Robin Hood's Bay in Yorkshire. This also was spheroidal, with a hard lump inside which shook about in a quantity of fine dust, obviously derived from the decay of a larger mass of which the remaining hard piece was the central part. The dust was quite dry, and the exterior coat of the nodule was only ¼ inch in thickness and composed of pyrites, the exterior being marked with parallel lines like water-marks. It was about 8 in. in the long diameter. I am not prepared with any reasonable account of the origin of such a nodule.

THE DRIFTS OF CARNARVONSHIRE.—Mr. Mellard Reade's interesting observations (**195**) clearly show that much of the drift near the west coast of Carnarvonshire has at some

time or other been in the sea, and that on the lower levels at least it has been stratified by water. Leaving out of account the sands of Moel Tryfaen—my paper on which (196) speaks for itself—I think no one will doubt that the deposits at the lower levels owe their present arrangement to water; but the absence of fossils other than remanié, the presence of which shows that shells could have been preserved if they had been present, seems to me to render it rather doubtful whether it was sea-water. Nearer Bangor there is much false bedding, the lamina in many cases having a sharp dip down the local slopes, a fact which rather points to the action of torrential water coming off the land; but they are very complicated, and may not all have been formed at the same time nor by the same agency.

THE RAISED BEACHES AND "HEAD" OF THE CHANNEL ISLANDS.—These have attracted the attention of no less than four authors (227–230). The former seem clearly to show two stages of submergence, one to about 25 ft. and the other about 60 ft.; but the clays, etc., present a more difficult problem. There are no heights from which they could have been washed down like ordinary "head," and the few flints are hard to account for unless they have been brought there by man.

SCANDINAVIAN BOULDERS IN THE EAST OF ENGLAND.—We have two independent witnesses, Mr. Harker and Mr. Madsen, that these can be definitely recognized. As pointed out, however, by Sir H. H. Howorth, it has not been made quite clear whether these boulders were actually *in* the Boulder-clay or always picked up on the shore, in which case they might be ballast brought by old Vikings. This could not well be the case if some from Dalame, on the opposite side of Sweden, are really included; but these appear to be less characteristic. In any case they do not in themselves prove an ice *sheet*.

GLACIAL THEORIES.—In this subject the event of the year reviewed is the bold attempt of Sir H. H. Howorth to prove that the whole belief in a Glacial epoch, which has formed the foundation of innumerable researches, and has been firmly held by a hundred good Geologists, is nothing but a nightmare (248). It is a gigantic task, and there is only one way to accomplish it. He who would overthrow

such a belief must visit all the more important localities where the observations on which the belief has been founded have been made, and by other observations of superior accuracy, or, by a better understanding *on the ground* of the bearing of those already made, show that the facts, as personally known, can be better accounted for in some other way. Whether or not Sir H. H. Howorth has actually made any such observations, it is no one's business to say, but certain it is that his book does not contain an account of them, and must therefore remain *vox et preteria nihil.* As to the substitution for the glacial theory that of a vast uplift of the sea bottom causing a cataclysmic wave to pass over the land, let anyone examine the drifts of Wales or Ireland, where the striæ and lines of travel of the boulders radiate from a centre, or the numerous successive drifts of the Trent basin, or indeed almost any other spot where there is evidence of local glaciation, as we call it now, and he will at once be convinced of the inadequacy of any such theory for this part of the phenomena at least. As to the more general phenomena, the only possible locality for such an uplift would be in the Arctic regions, and the wave produced would have to be strongest at its farthest limit to carry the materials of the great terminal moraine, and the enormous blocks which are scattered over the North German plain. But, really, the author can scarcely mean this hypothesis to be taken seriously. Meanwhile we have Dr. J. Geikie (**247**) going further than ever, and giving us four Glacial epochs and four intervening inter-Glacial periods, in spite of the tendency of American students to unite them all into one! This seems, however, to be a mere matter of appreciation, *i.e.* whether or not we are to regard the several glaciations as parts of one great whole, unless, indeed, Europe has been more often glaciated than America, and only one of the European epochs, probably the maximum one, corresponds to the single American.

THE CAUSE OF THE GLACIAL EPOCH.—The battle between the advocates of earth movements and those of astronomical causes still goes on, though there seems to be a tendency setting in to discard the latter. Whether or not the changes of the eccentricity and equinoctial line of the earth's orbit

are *the* causes of the Glacial epoch, there cannot be the slightest doubt that these changes have taken place, and that they must have had considerable effect on climate, so that they cannot in any case be ignored. The great difficulty seems to be that such causes are recurrent, and it is thought that records of their results ought to be preserved in the stratified rocks. This has always seemed to me to be an unwarranted expectation. The stratified rocks have been deposited in the sea, but the signs of the last group of Glacial epochs (not to beg the question whether there were one or more) are on the surface of the land. We have special "drift" maps, but none which single out any other formation; and the disbelievers in the "great submergence" can at least believe that on any submergence all these superficial deposits would be swept away, and their relics deposited in the ordinary stratified form, the boulders lasting no longer than the great blocks of hard rock, which are due to ordinary disintegration. So long as they are embedded in the clay they are preserved from destruction, but when that is washed away they will at once begin to decay, and only the finer sediment as a rule will reach the sea. When we see conglomerates containing large stones which have been brought a considerable distance, as for instance that of Budleigh Salterton, it is much easier to account for them as the relics of a former Boulder-clay washed down into the sea near the spot to which they have been brought by ice than in any other way.

"The True Horizon of the Mammoth." — On this subject also Sir H. H. Howorth attempts to show that Geologists generally have been wrong; since they have believed the animal to have lived in post-Glacial times. The venue of the discussion has this year been transferred to foreign countries, about which I have no personal observations to offer, but with regard to this country I think it must be admitted that the evidence for the post-Glacial age of the mammoth is not quite so satisfactory as might be desired. The occurrence of his teeth in many river gravels and clays no doubt creates the impression that he was living at the time of their deposit, but these gravels also contain stones derived from the Boulder-clay; and the teeth may

have been derived from the same source, while those in clay may have travelled further owing to their lightness. It is true that mammoth teeth are much more in Boulder-clay, yet they do occur. We may, therefore, dismiss from the list of decisive proofs all gravels and river deposits which contain merely isolated teeth. There still remain, however, three cases at least which to my mind appear more decisive. There are the cases in which there are found either large tusks which would have been destroyed or associated bones which would have been separated by any such transference from one deposit to another. These are: (1) Bielbecks in Yorkshire, where associated bones of mammoth occur in a lacustrine deposit with bones of other animals. These must have been living at the time when the lake was there. That time was no doubt considered by Prof. Phillips to be pre-Glacial, but the evidence appears to me to point the other way. The deposit lies to the west of the Lias outcrop, and the *Gryphea* of that horizon have been lifted by glacial action on to the top of the chalk hills to the east, showing the direction of motion of the ice. It can, therefore, scarcely be the ice that has carried the pebbles which overlie the mammalian bones towards the west, and we may better refer their transport to later pluvial action. That the mammalian deposits lie on the Keuper Marls is due to the valley being scoured out by the ice. (2) The Hornchurch gravel in connection with the Grays deposit. The latter contains large tusks and associated bones, and must therefore have been made when the contained animals lived, but no water could be flowing there till the river had excavated its valley to that depth, and this could not happen till post-Glacial times if, as Mr. Holmes has shown, the highest river gravel overlies the Boulder-clay. (3) The Endsleigh Street deposits with its mammoth tusks and bones described by Dr. Hicks, though interpreted by him in exactly the opposite sense. The same arguments apply as at Grays, and the overlying racy clay can easily be accounted for by being washed down; it is not true Boulder-clay, for it contains no boulders. That a similar clay underlies an Upper Boulder-clay at Finchley is no difficulty, for the washing down of a Boulder-clay at one period will probably

resemble the washing down of a Boulder-clay at a later period.

Boring near Northwich.—This boring, recorded in No. **311**, has demonstrated an extraordinary thickness of Keuper strata, viz. 2462 ft. As the surface indications did not lead Mr. De Rance to expect anything like so much, he concludes that a basin has here been struck. The occurrence of rock-salt in this area has always indicated that the Triassic sea, or salt lake, was finally reduced to a small size in this region, where it finally dried up, and this boring gives us an independent proof that the deepest part was here.

Boring in East Lincolnshire.—The remarkable feature in this (**315**) is the absence of the chalk where it had been expected, which leads Mr. Jukes-Browne to consider that it had been denuded prior to the glacial deposits, but only locally as the chalk returns at Skegness. It is remarkable, however, that there is a mass of chalk in a neighbouring boring, 10 ft. thick, which is underlain by gravel, and is therefore taken to be a boulder. That such huge masses of chalk do thus occur, is of course known, at Cromer, Ely, and as recently recorded (**243**) at Catworth, in Huntingdonshire. But I have lately had an opportunity of examining samples from the core of another boring near Skegness, and the result suggests caution; for in this boring one sample, said to come from below 100 ft. of chalk, and about 50 ft. of the strata which follow it below, is full of chalk fragments, and resembles Boulder-clay. Such an occurrence might be taken to prove the whole of the overlying mass to be out of place, but it is a little too thick and regular in succession for that, so it may be either a mistake or a fault may be crossed. This same boring shows that there is a fault between it and Skegness, a little to the south, all the strata being 110 ft. lower, and the chalk at the top five times as thick.

PALÆONTOLOGY.

Fossil Mammals.—The tooth of a mammal was recorded in 1891 (*see* No. **305**, 1891) from the Wealden of Hastings, and now we learn (**348**) that another mammalian tooth was collected many years ago, but has not been noticed till now. The Wealden has thus become the fourth mammaliferous

horizon in secondary rocks. It is curious that one of these teeth is compared to the marsupial-like *Plagiaulax*, and the other to the rodent-like *Bolodon* of America.

THE ELGIN REPTILES.—The great event of the year has been the publication, with full illustrations, of the descriptions of the new reptiles determined by Mr. E. T. Newton (**352**) from the hollow casts which their skulls and a few of their other bones have left in the Elgin Sandstone. The most wonderful is the ally of the *Pareiasaurus*, which itself was for the first time fully described last year (*see* No. **493**, 1892), and the others are very curious Dicynodonts, both being groups of South African reptiles from the Karoo formation. This points to a wide distribution of similar types of land animals at the same Triassic period, if this be indeed the age of both the sandstones. At that time the reptiles were, if not quite the most advanced, yet certainly the dominant type of animal; so that a general law, not entirely without confirmation in other cases, and abundantly illustrated in the case of man, that the dominant races at any time are also the most cosmopolitan, seems to receive further support from the new discoveries. From a palæontological point of view, it is at present impossible to doubt the Triassic age, but it is nevertheless to be noted that according to Dr. G. Gordon, who was, while alive, perhaps more familiar with the district than anyone else, and to whose exertions these discoveries are mainly due, the last stratigraphical evidences of separation of the containing rocks from those considered to be Old Red Sandstone, have been destroyed by further working of the sandstones (**147**).

NEW AMMONITES. — Last year (No. **281**, 1892) Mr. Buckman described 22 "species" of Ammonites, all referred to the genus *Sonninia*; this year he adds 25 species of the same genus, and there are at least 9 more to come in 1894. Every one of these 56 "species" have names originated by that author. There is no question but that he has far away the largest collection of Inferior Oolite Ammonites in the world, but still we are puzzled by the meaning of such an extraordinary result. We know, of course, that species in the original sense of the word have no real existence, and that the names assigned to different recognizable forms are merely terms of convenience for indicating the stages of

phylogenetic development of particular stocks; but still we are met with the question—*Are* so many names convenient? The author would doubtless reply that if we are to study the development of the group with accuracy such names are not only convenient but necessary, and from his point of view the reply holds good. Still the group is exceptional, and we cannot help feeling that the term "species," as used by others, stands for isolated examples of what the author calls "stocks," if not for several of such stocks; and it is inconvenient, to say the least, that the same term should be used in different senses. Meanwhile we can do nothing but suspend judgment on the value of the names assigned, and on the truth of the relations by which the forms are supposed to be connected.

EURYPTERIDS. — These have been carefully studied by Mr. Laurie (**395**, **396**), and the different genera more clearly defined. They still remain, however, so peculiar, that their relations cannot be definitely settled. It appears that they should not be called Crustacea, in spite of their aquatic mode of breathing, on account of their structural distinctness from any type of that group, so that the ordinary definition of Crustacea seems to require modification, as also does that of the Arachnids, if these are brought into closer relationship with them.

CARBONIFEROUS CORALS. — The beautiful drawings of Mr. Thompson (**412**), produced direct from nature, give a good idea of the internal structure of the two genera *Calophyllum* and *Campophyllum* studied by him; but when forty-five "new species" are described from transverse sections only, it is doubtful whether even Mr. Buckman would be able to accept them.

RADIOLARIA. — In contrast to the above over-naming is the description of the Radiolaria from Mullion Island by Dr. Hinde (**419**). Here well-marked forms are only provided with generic names. From a biological point of view this caution is doubtless by far the safest attitude to adopt, but when others are found it will be somewhat difficult to indicate their similarity or otherwise to these first discovered. There seems at present to be no recognized rules as to the most desirable amount of distinctness of nomenclature.

PALÆOBOTANY.

CYCADS IN THE COAL-MEASURES.—Some of the vegetable remains of the Coal-measures have before now been referred to the *Cycadaceæ*, and the addition of so little known a plant as *Myeloxylon* to this group (**433**) would attract, perhaps, but little notice, but to claim the constantly occurring foliage known as *Alethopteris* as a Cycad is a rather startling proposal. The name would become peculiarly inappropriate, but it must be confessed that it has always been difficult to demonstrate the difference between Cycadean and Pteridean venation on the fronds of that plant.

MICROCHEMICAL ANALYSES OF MINERALS. — There is a border-land between chemistry and geology which is without very definite boundaries, and in this lies the valuable paper (from one or other point of view) of General McMahon (**441**). A full abstract of Part ii. has been given to indicate its nature and value. But its greatest use to Geologists will doubtless lie in the plates, where the forms assumed by the different sulphates are figured. It should be possible by becoming familiar with these figures to be able in some cases to definitely assert the presence and even the relative proportion of some of the critical elements, even in part of a rock slice.

OPTICAL DENSITY.—The idea that we are to obtain from Prof. Sollas' paper (**444**) is, that by studying the optical characters of mineral sections cut in different directions we can obtain a clue to the arrangement of the atoms in the molecule of which it is composed, and thus arrive at its true constitutional formula. It has as yet only appeared in an abbreviated form, and the publication of the full memoir must be awaited before the proofs offered can be fairly tested. Meanwhile we have this idea to consider, that "the density of a crystal may be different in different directions." The word "density" is obviously here used in a sense distinct from that which it usually bears, for "density" is not a *directed* quality. The conception appears to be that a ray of light passing through a crystal in a certain direction may meet with certain constituent atoms only, and if passing through in another direction will meet with other constituent atoms. If the mineral were all composed of the first set it

would have a certain density, and if of the second set, another; and the density of the actual mineral will be compounded of these two in proportions dependent on the arrangement of the atoms in one or other direction. The correctness of the supposed grouping of these sets is tested by the comparison of the atomic volume of the whole with the sum of the atomic volumes of the parts as thus determined. If this be the meaning of the author, and it is the only way in which I can conceive, even with the author's aid, a directed density, then while the idea is a seductive one, and one is persuaded there *must* be *something* in it, yet when pushed a little farther difficulties seem to crowd in. In the first place vertical and horizontal do not exhaust the dimensions of the molecule, yet only two dimensions seem allowed for in the calculations. Next, are the amplitudes of the light waves greater or less than the molecule? If greater, the molecule must move as a whole; if less, then the path would have to be so matched that the vertical ray should not meet one of the horizontal molecules; and finally, how is this effected by the difference either of amplitude or of wave length in different rays. This may be all talking in the dark, for I find it impossible to get a clear conception of how matters are supposed to be arranged. It is much to be hoped that thė full memoir will explain the details of the idea. At the same time it is perfectly clear that a molecule may be, and if heterogeneous as to its atoms, must be, so constituted as to effect the ethereal vibrations differently according to their direction; and these differences may be made to indicate in some way the molecular constitution. The difficulty comes in when we, or at least I, try to connect this with *density*.

PETROLOGY.

DENSITIES OF SOLID AND LIQUID ROCK. — Dr. Barns' results (**457**), showing an increase in bulk of a rock on passing into a molten condition by as much as 10 per cent., seem to have geological bearings which I do not remember to have seen indicated, though the difference of density in a crystal and the corresponding glass is well known. If in the interior of the earth the heat is in any way directed

to a spot where the rocks are solid, and melts them, they must, especially if basaltic, as were the rocks experimented on, be greatly expanded. This expansion cannot well take place within the earth, unless by the uplifting of neighbouring rocks, which may be a cause of upheaval, but will, if any outlet be afforded, take effect by driving the molten mass upwards, and this would account for the welling up of the lavas of Hawaii, and for the extension of great sheets of lava in the case of the fissure eruptions.

His second set of experiments is also geologically instructive. If between the temperatures of 829° C. and 1378° C. the thermal capacity of diabase is doubled, *i.e.* from ·191 to ·385, what becomes of calculations as to the flow of heat in the earth based on the assumption that the thermal capacities are constant? (*see* No. **3**, 1892).

THE POSSIBILITY OF DYNAMO-METAMORPHISM. — Doubt is often thrown by Geologists on the possibility of mechanical force directly producing chemical reaction, *i.e.* without the aid of heat. Such would do well to ponder on the paper by Mr. Lea (**459**), in which he shows that reactions which would retard, or which at least cannot be produced by heat, may be produced by mechanical, and in particular by shearing, force.

THE DARTMOOR GRANITE.—General McMahon (**478**) has come to the lists to do battle for the older view, which Mr. Ussher in No. **366**, 1892, attempted to supersede. He shows that veins proceed from the granite into the slate, which must therefore be young unless the veins are the result of dynamo-metamorphism. It appears that these veins show broken crystals and a quartz-felspar mosaic, and as he does not consider the veins to have suffered dynamo-metamorphism, he wishes us to believe that these structures do not necessarily indicate this process; but fracture and reconstruction *do necessarily* indicate mechanical force on a solid substance, *i.e.* one which can be broken, though not the *time* at which the force was excited. The other arguments do not seem likely to give Mr. Ussher much trouble to answer.

A NEW ROCK.—The neighbourhood of Loch Borolan in Assynt has actually furnished us with a type of rock of well-marked character not known before. It is necessarily a com-

pound of orthoclase and black garnet, with indications of nepheline before alteration; hence it is referred to the foyaite family. The special appearance, however, which marks the actual rock is the occurrence in it of white patches, in which the garnets are absent but the soda minerals present. It is an intrusive rock, and it does not seem that any reason can be suggested why it should be so unique in character.

ZONES OF METAMORPHISM.—It is usual in geological maps of districts where metamorphism has been produced by contact with an igneous mass, to surround the latter with an aureole which gradually fades away, indicating that the metamorphism differs in one part from that of another only by its amount of completeness. Mr. Barrow, however, in No. **482**, introduces us to what would be, if carried out, a new kind of mapping, for round the igneous mass which he has studied comes a sillimanite area where metamorphism has produced that mineral, and this must have a boundary; then comes the cyanite area with its boundary, and then the staurolite area. These several areas do not, we are told, coincide with definite groups of original rocks, but pass across more or less from one to the other; so that we should have on the map one set of lines for the original rocks, and another for the areas of distinct varieties of metamorphism. The relation of these two sets of lines to each other should show from what range of material the several minerals mentioned above could be formed, and thereby perhaps the dependence of the apparent amount of metamorphism in any area on the original nature of the rocks metamorphosed. Thus the material in one rock may be more suitable for the production of sillimanite than those of another, and hence in the former the metamorphism may appear greater, and this would be also the case if that mineral definitely required a certain temperature for its formation, since one rock may differ from another in conductivity. There is obviously much to be yet made out in this direction.

Mr. Barrow also makes a remark which points to what appears to be a somewhat neglected consideration (that is, unless we admit a metasomatosis, such as is claimed at the Malverns by Dr. Callaway). He speaks of certain rocks being necessarily originally sediments, because in their composition there is too much alumina, or silica, to correspond to any

known mineral forming igneous rocks. This is a sort of geological surveying by chemical analysis, of which perhaps we have not had enough as yet, *e.g.* as when almost the whole of the Hebridean rocks are claimed as igneous.

THE CONTROVERSY OF THE SKYE ROCKS.—Only one side of this question is illustrated in the year reviewed, viz. that by Prof. Judd (**488**). By the publication of the papers Geologists are in a measure invited to come to their own conclusions as to which is right, but when such opposite views are held by two men who have both examined the district with great care, outsiders will probably prefer to remain as such for the present. The principal question which the present communication suggests to such is this: How comes it that the spherulites, if the result of the alteration of a granite by the surrounding gabbro, come to lie in parallel lines, and not to be related in their distribution to the boundaries of the included mass?

THE RANGE OF THE INTERCHANGE OF ROCK MATERIAL.—Side by side (**499, 500**) stand two papers in which diametrically opposite conclusions are arrived at on this point. On the one side there is Mr. Harker, who (**499**) would limit it to $\frac{1}{20}$th of an inch, and on the other there is Dr. Callaway, who (**500**) can see in massive quartzite the result of the alteration of a gabbro. Of course the circumstances may be different, but it is probable that to very few minds the apparent passage in the field of one rock into another of quite a different composition, even if confirmed, would carry with it even the notion, much less the demonstration, that the one was derived from the other by interchange of material or by the loss of much of the bases.

ECONOMICS.

THE ROYAL COMMISSION ON WATER SUPPLY.—The questions of storage dealt with in this report, though of enormous practical, are of little theoretical, interest: the main point to be noticed is the contest between the "cistern" and the "river" theories of underground water. The Commissioners decide, as far as their requirements are concerned, in favour of the latter. They may, perhaps, be put in this way: If water be pumped out of a bucket,

the level in the bucket must be lowered wherever the bottom of the tube of the pump may be placed (the cistern theory); but if the bucket has an open tap at the bottom, and the level is kept up by the water flowing in at the same rate, this level will not be altered by attaching a pipe to the tap and making use of the water (the river theory). As water is certainly always flowing in, and the level does not rise to a corresponding amount, it must be also flowing out somewhere: the problem then is simply to find out where this is, which must necessarily be done by experiment.

MAPS AND SECTIONS.

THE ENLARGED REPORT ON THE GEOLOGICAL SURVEY.—This year a new departure has been taken in giving the conclusions of the Geological Surveyors on various points in the report of the Survey (**568**). At first sight this seems to be an advantage, and where the statements are simply novelties of fact, which no one would think of disputing, it undoubtedly is so. Where, however, the views of individual Surveyors on highly complicated questions are given, necessarily without the evidence on which those views are founded, the only advantage (?) derived from their publication is the substitution of authority for scientific proof.

FOREIGN GEOLOGY.

THE SUBMERGENCE OF WESTERN EUROPE.—The views propounded last year (No. **156**, 1892) by Prof. Prestwich as to the indication by the rubble drift of a great submergence of this country in the latest portion of the Glacial epoch, necessarily required confirmation by the examination of similar deposits or other indications of change throughout Europe. The author, therefore (**592**), now gives an account of the European evidence. Unfortunately his remarks cannot carry quite so much weight as in the former instance, as he himself confesses that his personal observations are limited to parts of France and Italy. The evidences brought forward are of three classes, namely, raised beaches and head, the loess, and the ossiferous fissures. With regard to the first class, similar remarks to those made last year will apply again. With regard to the last, the author certainly draws

a very vivid picture of the poor beasts caught between the cliff behind and the rising sea in front, till they were huddled together into a cave, or utterly destroyed, and their remains washed down into a fissure; but is this the only possible explanation? With regard, however, to the loess, something more definite may, I think, be said. The author rejects the Eolian theory, but he has not seen the loess of the Rhine valley. I think it would be almost impossible for anyone to see it there, and doubt its Eolian character. The only sign of water action is that of percolation from the surface: the whole mass is unstratified; there are the old root marks; it is filled with land shells of the ordinary dune-loving type; and the material is not of that clean character which all subaqueous deposits more or less exhibit; and the only difficulty is that the bones it occasionally contains are isolated, but at best their presence is accidental, and an accident of preservation may be accompanied by other accidents of destruction. Is not the loess, in fact, a very strong proof that the land where it lies has never been submerged, as otherwise it would become stratified? At the lower levels where the river water has reached it, it is so, but at higher levels it retains all the above-mentioned marks of a subaerial origin. Perhaps we have not yet realized the complexity of the phenomena of Quaternary times, during which the land at one time, or in one place, may have stood at a higher, and at another time at a lower level, as witnessed by the ossiferous caves of Malta (**610**). In this case the author, Mr. J. H. Cooke, invokes both conditions, accounting for the filling of the cave in a similar way to that described by Prof. Prestwich, during one of the stages of this oscillation of level.

New Minerals. — We have this year the full account (**651, 653**) of the two new minerals Geikielite and Baddeleyite introduced last year, and another discovered by chemical analysis—Stibiotantalite.

The Formation of Secondary Minerals of Large Size. — Everyone who has examined altered rocks is of course thoroughly convinced of the development of new minerals in them, but if, as previously indicated, there is some doubt how far the materials for their formation can

migrate, it becomes of special interest to discover the maximum known size of such minerals. The figures given by Prof. Bonney (**669**), especially that of the hornblende crystal, show that such crystals may reach a length of $\frac{3}{4}$ inch, and in this case the length is measured actually across the lines of contorted foliation, so that the secondary origin is absolutely beyond dispute.

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* *Indicates that the abstract has been approved by the author.*

ANNALS OF BRITISH GEOLOGY,

1893.

GENERAL GEOLOGY.

GENERALITIES.

1. Preston, S. T.—On the supposed Conflict between Geology and Physics.

Geol. Mag., Dec. 3, vol. x. pp. 87-89.

The author thinks that "the matter whose collision formed the sun was originally in a state of motion," and thus that more heat may, on this account, have been stored in the sun than would have been the case if that body "was formed by the gravitational approach of widely diffused matter in a primitive state of rest," which greater amount he also thinks will lengthen the time during which the earth has been habitable. He further suggests that when the sun was larger the earth was farther off from it.

***2. Reade, T. M.—Measurement of Geological Time.**

Geol. Mag., Dec. 3, vol. x. pp. 97–100.

The author points out that if we are to measure time by the amount of sediment deposited, we must remember that the same materials have been used over and over again, and have all been primarily derived from pre-Cambrian or from igneous rocks. The available exposed areas of the former would gradually decrease as they were covered up by sediment; but their mean area, plus the area of erupted rocks, is assumed for the purpose of calculation to be one-third of the present land area. He next assumes that the average thickness of the earth's sedimentary crust, down to the base of the Cambrian, is one mile; next,

that there is as much sediment under the sea as there is on land; and, lastly, that the rate of erosion of pre-Cambrian and igneous rocks is one foot in 3000 years. From these premises he deduces that the time which has elapsed since the commencement of the Cambrian period is $5280 \times 2 \times 3000 \times 3 = 95,040,000$ years.

3. Gooch, A. E.—On the Age of the Earth.

Collected Tracts. Kenny, printer. Ent. at Stat. H. pp. 1–15.

The author points out our ignorance on innumerable data respecting the sun, so that the argument as to the earth's age from the loss of heat from the sun is unreliable, Amongst these data is the state of rest or motion of the original condensing matter as discussed in No. 1. The argument from the shape of the earth in connection with its rate of rotation and the tidal retardation is met by the statement that the earth will always adjust its shape to the rate of rotation at the time. For the argument from the internal heat of the earth several data are unknown. The weaknesses of the geological estimate are then displayed.

UNDERGROUND TEMPERATURE.

*4. Everett, J. D.—Nineteenth Report of the Committee . . . appointed for the purpose of investigating the rate of increase of Underground Temperature downwards in various localities of dry land and under water.

Rep. Brit. Assoc., 1892, pp. 129-131.

In this report an account is given of a deep boring at Wheeling, West Virginia, of which a preliminary notice has been published by Mr. Hallock, in the American Journal of Science. The boring, which contains only air, is 4500 ft. deep, and the temperature was taken by immersing thermometers in zinc buckets 3 ft. long full of water, and suspending these at different depths for 24 hours. To test whether the readings were affected by convection currents, two series of woollen wads were placed 10 ft. apart, on either side of the thermometers, but it was found that the same temperatures were recorded by a thermometer between the wads, and a thermometer above the upper, or below the lower wad. In order to account for the absence of convection-effects thus shown, the committee point out that though air is more easily put in motion by differences of temperature than water, yet its circulation would be retarded by the roughness of the sides of the borehole and its thermal capacity is so small that the heat abstracted by it does not appreciably affect the temperature of the walls.

The following are the recorded observations:—

Depth, ft.	Temp. Fahr.	Depth.	Temp.	Depth.	Temp.
1,350	68·75	2,740	83·65	3,875	100·05
1,591	70·15	2,875	85·45	3,980	101·75
1,745	71·70	2,990	86·60	4,125	104·10
1,835	72·80	3,125	88·40	4,200	105·55
2,125	76·25	3,232	89·75	4,375	108·40
2,236	77·40	3,375	92·10	4,462	110·15
2,375	79·20	3,482	93·60	—	—
2,486	80·50	3,625	96·10	—	—
2,625	82·20	3,730	97·55	—	—

Above the depth of 1591 ft. the borehole was cased, and no reliance is placed on the indications, but below that depth the temperature is shown to rise 1° in 92 ft. for 244 ft.; then 1° in 84·5 ft. for 651 ft.; then 1° in 80·6 ft. for 746 ft.; then 1° in 62·4 ft. for 643 ft.; then 1° degree in 58·1 ft. for 587 ft. The temperature of the ground at 100 ft. below the surface is 50°·3. This, compared with the bottom temperature, gives a mean increase of 1° Fahr. in 94·1 ft.

5. Stainier, X.—Temperature observations in a deep Coal-pit sinking in Belgium, with analysis and temperature of a spring of water at a depth of 3,733 feet.

Trans. Geol. Soc. Manchester, vol. xxii. pp. 204, 205.

The bore-hole starts at 246 ft. above sea-level, and on reaching a depth of 3773 ft. the temperature was found, on one occasion, to be 116°·6 Fahr., and on another 111°·2 Fahr. At the face of a cross-cut at the bottom a spring issued at a temperature of 118°·4 Fahr., and in another cross-cut the temperature was 104° Fahr. Thus the mean increase of temperature is 1 Fahr. for 54 ft. The spring-water had a spec. grav. of 1040, and contained 59·8 grammes of salts per litre—viz., calcium carb. 0·716, magnesium carb. 0·184, iron carb. 0·006, calcium sulphate 9·468, magnesium sulphate 14·352, sodium sulphate 0·052, calcium chloride 2·868, magnesium chloride 3·092, sodium chloride 38·029, sodium iodide 0·015, silica 0·018.

6. Daubrée, M.—Petroleum Measures in Lower Alsatia with abnormal underground temperatures.

Colliery Guardian, vol. lxvi. pp. 541, 542.

Read to the Academie des Sciences, Paris. These petroleum measures are worked by about 500 boreholes, which yield different results, even when close together. In these boreholes

the following rise in temperature has been marked as greater than usual:—

Depth in metres.	Degrees Centigrade.
305	47·5
330	52·5
360	53·7
400	57·5
420	58·7
480	58·7
510	60·0
540	59·4
580	59·4
600	60·6
620	60·6

RECENT DEPOSITS.

7. Holland, P., and Dickson, E.—Remarks on the formation of Clay.

Proc. Liverpool Geol. Soc., vol. vii. pp. 108-117.

The authors having found that clay is not a usual product of glacial streams [No. 27, 1891], they now attempt to discover the conditions necessary for its production. Clay is defined chemically as hydrated silicate of alumina, and physically as a plastic substance. To produce such a substance mechanically they have ground up a mixture of various rocks, such as a glacier might denude, and the finest portion of this was still found not to be plastic: hence they conclude that the action of carbonic acid and water must be necessary, and accordingly they exposed some of this powder to these agents under pressure for twelve months. The filtrate from this is found to contain lime, magnesia, iron-oxide, and a trace of potash.

Attention is also drawn to some decayed diabase from a granite quarry at Fort Regent, S. Helier, Jersey, The decayed part has a spec. grav. of 2·59, while the unaltered rock has a spec. grav. of 2·92. The following analyses are given:—

	Decomposed.	Sound.
$Si\,O_2$	44·93	43·56
$Al_2\,O_3$	16·27	14·58
$Fe_2\,O_3$	13·37	3·84
$Fe\,O$	—	7·00
$Mn\,O$	0·28	0·39
$Ti\,O_2$	1·34	1·03
$Ca\,O$	1·84	10·78
$Mg\,O$	6·49	9·95
$K_2\,O$	0·84	1·02
$Na_2\,O$	2·03	1·86
$C\,O_2$	—	1·93
$H_2\,O$	12·55	3·85
	99·94	99·79

A similar comparison is made of the granite (A), the decomposed part at the surface (B), and the adherent clay (C).

	A.	B.	C.
SiO_2	70·23	71·22	48·44
Al_2O_3, TiO_2	14·73	14·92	27·24
Fe_2O_3	2·37	2·36	5·04
FeO	0·98	0·07	—
MnO	0·18	0·20	0·38
CaO	0·94	0·44	0·38
MgO	0·50	0·68	2·93
K_2O	5·13	4·10	7·43
Na_2O	4·19	4·25	0·35
H_2O	0·70	2·10	7·91
	99·95	100·34	100·10

This clay appears to have been formed *in situ* by the percolating water, and not to result from the simple admixture of the finely ground rock with water.

Two analyses are also given of a red sandstone and a red sandy clay at Brereton, near Rugeley, the bearing of which is to be discussed in a future paper.

8. Murdock, J. B.—Notes on a visit to the Culbin Sands, Morayshire.

Trans. Geol. Soc. Glasgow, vol. ix. pp. 406–413, plate xvi.

These sands lie on the south side of the Moray Firth, and they have become 11 ft. higher since the ordnance survey was made. They show the usual greater slope on the leeward side, and have abundant ripple-marks. In the seventeenth century these sands encroached upon and buried the Culbin estate, the buildings on which were again uncovered at the beginning of the present century, but now they are once more covered. On the seaward side is seen a raised beach with shell mounds, including oyster shells in abundance, though that mollusc is now almost extinct in the firth; with these are found numerous flint implements. The Findhorn river is the original source of the sand, which is first carried out to sea, then brought back by currents, till it reaches Findhorn Bay again, the river having thus been driven some miles eastward of its old course. The old stones at the base of the hill have all been polished by the sand-blast. The plate is a map of the district from a paper by G. F. Black, "On the Archæological Exploration of the Culbin Sands," in the Antiq. Soc. Scotland, Proc. 1891.

*9. Hutchinson, H. N.—Deep-Sea Deposits.

Knowledge, vol. xvi. pp. 43-46, 65, 66, 94-96.

Popular articles giving the information published in the recent "Challenger" Report [No. 6, 1891], with reduced charts of the

oceanic deposits, and a reproduction of one of the plates in Kent's "Great Barrier Reef" [No. 20].

GLACIAL AGENCIES.

*10. Woodward, B. B.—Glaciers.

Rep. and Proc. Ealing Micr. and N. H. Soc., 1892, pp. 32–36.

Abstract of a popular lecture.

11. Grossmann, K.—Observations on the Glaciation of Iceland.

The Glacialists' Magazine, vol. i. pp. 33-45, with a plate and map.

Near Reykjavik glacial striæ are seen running S.E. and N.W.; further north on the incline of Kaldedalur they run S.S.E. and N.N.W.; northward of Northtunga they run either W. 10° N. or W. 40° S.; on Hrutaforthur N.E. or 10° N. of this; on the Hill of Vatnsdalhólar S. 43° E., S. 40° E., E. 15° W., N., and N. 15°-30° E., and here also there are many *roches moutonnées*. There are many signs of glaciation in the way of drifts and fjords at Holar, and many boulders strew the slopes of Eyjalfjorthur. At Dettifoss the striæ run N. 35° E. (All these directions are magnetic ones, the declination varying from 35° to 45° west.) The hills near Hnansar, which by Zirkel are considered due to earthquakes, and by Schmidt to volcanic eruptions, are thought by the author and by Thoroddsen to be of drift origin. Figures are given of them which show them to be conical in shape, but as they are more convex on one side than on the other, it is supposed that the ice which brought the drift must have come from the more convex side. These observations show that there was formerly a depth of ice of at least 1,500 ft. and on Eyjalfjorthur of 1,900 ft., and this ice radiated from the centre of the island.

*12. Hall, Marshall.—Glacier observations, more especially Colonial.

Geol. Mag., Dec. 3, vol. x. pp. 349-353.

Discusses what enquiries should be made by travellers concerning the retreat and advance of glaciers, and draws attention to a memorandum recently sent out by the Alpine Club.

13. Bonney, T. G.—Do Glaciers Excavate?

The Geographical Journal, vol. i. pp. 481-499.

The author first draws attention to the distinction between abrasion and excavation. The actual contours in the glaciated

parts of the Alps are very different from those of the summits, but though the surface is rounded the old glaciers have left the "V-like section so characteristic of ordinary fluviatile erosion" undestroyed, and have not materially deepened them. With regard to tarns, these are comparatively rare, and those which lie in rock basins occur either in corries or at the back of low ridges of rock. "In these two situations a semi-solid substance like glacier ice might put forth considerable erosive power." The areas deserted by glaciers on their retreat are not found in the Alps to have been eroded, nor on their advance do glaciers remove all the loose material that lies in their path.

Various difficulties are then raised as to the low position of several of the lakes, as to their absence in some of the valleys where they might equally be expected, and as to the branching forms of some, particularly of Lugano and Como. Also the sublacustrine contours of Lake Geneva are not what we should expect on the erosion theory. With regard to the lake-shaped bottoms of fjords, difficulties arise when we enter into details. The author's own theory is that the lakes occupy ordinary valleys in which there have been differential movements; the resulting changes of dips would, he considers, be too small to be noticed. As examples of lakes which have undoubtedly been so produced, the great lakes of America are cited.[1]

*14. Wallace, A. R.—The Glacier Theory of Alpine Lakes.

Nature, vol. xlvii. p. 437.

This is a letter in reply to the Duke of Argyll (p. 389). The writer argues that if lakes are due to earth-movements it is curious that such movement is always confined to glaciated areas, and also to areas occupied by the softer rocks, and to positions where glacier streams have converged. Moreover, in order to produce a lake the earth-movement must take place at a greater rate than the denudation can keep pace with, and this, he thinks, is not often the case.

The Duke of Argyll (p. 485) replies that the lakes are also always in areas where earth-movements have certainly taken place, *i.e.* in mountainous regions.

J. C. Hawkshaw (p. 558) also remarks that the lakes may have been preserved where protected by glaciers, though not originally formed by them.

[1] For a reply to this paper, by A. R. Wallace, see No. 260.

15. Officer, Graham.—The Glacier Theory of Alpine Lakes.

Nature, vol. xlviii. p. 198.

The author cites an instance where there is a lake but no sign of glaciation. This is Lake St. Clair in Tasmania. It is at 2500 ft. above the sea-level; its area is 11 miles by 2 miles, and its depth 590 ft. There are also smaller lakes at higher levels. The rock in which these lie is a sandstone resting on a greenstone plateau.

16. La Touche, T. D.—The Erosion of Rock Basins.

Nature, vol. xlix. pp. 38-41.

The author thinks that light may be thrown on the question of glacial erosion by an examination of certain glaciers in the Himalayahs, of one of which—in the Bhutna Valley, Zanskar Range, Cashmere—he gives a view. The upper part of this glacier is on a slope, the middle part nearly on the level and comparatively free from boulders, while the lower part is all covered with moraine-stuff. It is near the junction of the first and second of these parts that we should expect to find a rock basin, as it is here that rocks which drop into the crevasses will form moulins, and thus, as is supposed, excavate the basin. Nevertheless, rock basins are not numerous about this spot.

R. D. Oldham (p. 77) says that the same is true in other Himalayan valleys.

***17. Irving, A.—On the Work of Glaciers.**

Natural Science, vol. iii. pp. 58–61.

A notice of No. **13**. The author reiterates his previous conclusions on glacier work and on the origin of lake basins by subsidence, as set forth in his papers on the "Mechanics of Glaciers" and the "Origin of Valley Lakes," as confirmed by later observers.

18. Munro, R.—On a remarkable Glacier Lake, formed by a branch of the Hardanger-Jökul, near Eidfjord, Norway.

Proc. Roy. Soc. Edinburgh, vol. xx. pp. 53–62, with a plate.

Lakes produced by a glacier entering a main valley from the side and throwing their moraine as a dam across it are not uncommon, but those produced by the glacier of the main valley damming up a tributary are far more rare, the Marjeelen See and one in the Dranse valley being the only known examples. The author now describes a third above Eidfjord. A stream which enters this fjord may be traced back to a waterfall called Remidalsfoss, above which is a lake called Remidalsvand, into

which a glacier enters from Hardanger-Jökul. Now this glacier further up crosses the front of a ravine bounded by a peak called the Lure Nut. The stream which runs in this ravine is thus dammed back by the glacier, until it rises, as in other cases, to the level of the surface of the ice, over which any more water flows away. Occasionally, however, it forces a way through the bottom of the ice and rises up through it at a lower level like a number of geysers, and flows on into the Remidalsvand, which thus acts as a partial protection to the valley below.

ORGANIC AGENCIES.

***19. Gwinnell, W. F.—Rocks of Animal Origin.**

Western Micr. Club, Als. Proc., 10th session, pp. 5, 6.

A popular notice.

20. Kent, W. S.—The Great Barrier Reef of Australia: its Products and Potentialities.

London: Allen. Fol., pp. 307, with 48 uncoloured and 16 coloured plates and a map.

This handsome volume is perhaps only remotely geological; but as coral reefs are frequently discussed from a geological point of view, the magnificent photographic representations of the living corals as seen where they grow will give a better idea than could otherwise be had of the true nature of a barrier reef, and thus be of geological interest.

21. Ingleby, J.—Corals and Coral Islands.

Trans. Leeds Geol. Assoc., part viii. pp. 9–14.

A general discussion on their mode of formation.

22. Beddard, F. E.—Earthworms and Earth History.

Natural Science, vol. iii. pp. 109–111.

It is pointed out that as earthworms are killed by salt water and have feeble means of distribution, they afford valuable indications of the former connection of the lands in which allied species occur. In particular, the genus *Acanthodrilus* is characteristic of New Zealand, of the parts of Australia nearest to it, and of Ethiopian Africa and Patagonia, and thus indicates the existence of a former Antarctic continent, with arms stretching out to these various lands.

23. Miall, L. C.—The Distribution of Plants and Animals as affected by the Past History of the Earth.

Trans. Leeds Geol. Assoc., part viii. pp. 74–76.

A lecture on the general subject.

***24. Sollas, W. J.—Seaweed tracks in Sand.**

The Irish Naturalist, vol. ii. pp. 225, 226, plate vi.

Some marks on recent sea-shores may be traced back till they are seen to commence at a seaweed to which small stones are attached, which the seaweed drags along in drifting, and so produces the worm-like tracks.

***25. Aitken, H.—The Formation of the Earth's Crust and its Destruction.**

Trans. Fed. Inst. Mining Eng., vol. vi. pp. 210–214.

The author cannot understand the wide area covered by uniform strata, as rivers entering lakes do not deposit such. Nor can he find any water-worn sand grains in the Coal-measure sandstones. He accordingly suggests that all the strata were precipitated from water by micro-organisms or "selectors." "Coal, ironstone, sandstone, shale, etc., were formed at one and the same time." "The writer is perfectly aware that his theory will be treated at first as absurd." He has seen no evidence of granite being an igneous rock. He also believes that the disintegration of rocks is due in great part to microbes, and can be stopped by putting poison on the rocks or stones.

DISINTEGRATING AND ERODING AGENCIES.

***26. Cole, E. M.—Erosion of the Yorkshire Coast.**

The Naturalist for 1893, pp. 142–144.

Certain measurements were made in 1889 for further use at various spots close to the coast. These spots have been revisited and the measurements again taken. In all cases they have diminished in the interval. From these it is determined that the coast has been eroded at Sewerby 6 ft. 10 in. in one place and 7 ft. 7 in. in another, during three years five months; at Sands Cottage, Bridlington Bay, 10 ft. 9 in. in one place and 4 ft. 5 in. in another, during two years ten months; and at Hildersthorpe 10 ft. 6 in. during one year and six months. Hence the erosion south of Bridlington is three times as rapid as on the north. Other measurements have again been taken for future use. At Kilnsea a stone in the wall of the "Blue Bell" Inn is stated to have been 534 yards from the sea in 1817; it is now only distant 341 yards. On a cottage near the same spot there is a similar stone with a record of its distance from the sea being 476 yards in 1858; it is now distant only 343½ yards. Hence the erosion is very rapid here.

27. Andrews, Mary K.—Denudation at Cultra, co. Down.

Irish Naturalist, vol. ii. pp. 16–18, 47–49, with frontispiece.

On the beach at Cultra Point there stand the relics of an old pump which was formerly used to remove the water from a quarry once worked there. It is now 50 ft. from the line of high water, and is covered with 3 ft. of water at high tide. In 1829 the quarry was 50 ft. from the sea, with a broad carriage-drive and fields between. At Cooper's Bay also the sea has encroached about 150 ft. during living memory, Cooper's Green having disappeared. The quarry and road at Cultra are marked on the 6-inch ordnance map engraved in 1834, but in that engraved in 1860 they are absent. In Belfast Lough the 3-fathom line is 800 ft. nearer to Belfast in the Admiralty Chart for 1891 than in that for 1856. The rocks here are Triassic sandstones and Carboniferous shales, and they are most denuded where they have not been indurated by the intrusion of trap.

28. Bodington, A.—Geology in the making.

International Journ. Micr. and Nat. Soc., vol. iii. pp. 312–315.

Accounts of changes on the coast of New Jersey, derived from the recollections of old inhabitants, are given. "Old Auntie Willetts, now dead and gone, used to milk the cows alongside of what we call the Black Rock; that's gone too, and I should think it's sunk considerable, for it's little more than the top of it that we can see at neap-tide."

***29. Paul, J. D.—St. John's Stone.**

Trans. Leicester Lit. and Phil. Soc., vol. iii. pp. 262–266.

In the Abbey fields, Leicester, there stood in former times an upright block of sandstone, which has now disappeared. Its site shows that it was not inserted into any hole, though it stood 7 ft. high. The floor is composed of cemented sandstone; and the author concludes that the stone was a natural pillar or cemented pipe, like those of smaller size which are now found in a neighbouring sandpit, and which also project from a cemented sandstone floor.

***30. Shone, W.—Subterranean Erosion.**

Geol. Mag., Dec. 3, vol. x. pp. 142, 143.

In reply to No. **23**, 1892. The author is quite prepared for the general application of his principle, even to contorted drifts, and to the thick coals of South Staffordshire, etc.

***31. Woodward, H. B.—The Underground Waste of the Land.**

Natural Science, vol. ii. pp. 124–128.

Subterranean erosion may be mechanical as well as chemical. In the former case it is sometimes suggested by the irregular

surface of clays beneath sands or gravels, and in this way the overlying beds may be separated into outliers. In like manner when clay overlies limestone it may crack and admit carbonated water to the limestone, thus forming fissures into which the clay will slip.

***32. Lebour, G. A.—On certain Surface Features of the Glacial Deposits of the Tyne Valley.**

Advance reprint from the Nat. Hist. Trans. Northumberland, Durham, and Newcastle-on-Tyne, vol. xi. part 2.

On the north side of the Tyne, near Corbridge, there are thick deposits of glacial sands overlying Boulder-clay. At the eastern end the beds are seen to have a high dip towards the side valley, and when two such valleys are near together an apparent anticlinal is formed. In the high ground above there has also recently appeared a vertical hollow 5 or 6 ft. deep, and there are other, older, depressions with sloping sides. The origin of these hollows is considered to be subterranean erosion by the springs which carry away the lower portions and let the upper part sink down. From these observations the author concludes that the surface features of the district are not the same as they were at the close of the Glacial epoch, but that they have been produced subsequently. He also points out that the anticlinal structure supposed to be characteristic of kames, and the kettle-holes supposed to be characteristic of moraines, may be due in some cases to later subterranean erosion.

33. Holgate, B.—Some examples of Change in Rock caused by the Permeation of Underground Waters.

Trans. Leeds Geol. Assoc., part viii. pp. 70–74.

A summary of the well-known instances of minerals formed in rocks subsequently to their consolidation, with an explanation of their origin.

34. Anon.—Daubrée on the Geological Work of High Pressure Gas.

Nature, vol. xlviii. pp. 226–228.

M. Daubrée has exploded dynamite and gun-cotton in steel cylinders, so as to produce sudden pressures of 1100–2400 atmospheres, and has subjected cylinders of various rocks to the force of the explosion. Slate was faulted, limestone and granite were first crushed, and then re-cemented into solid rock; they were also eroded. When the rocks are perforated, the sides of the perforation are found to be scored. One conclusion from these experiments, is that as the diamond-bearing pipes of S. Africa are found to run in lines they correspond to a fracture

in the crust, the particular holes being determined by cross fractures and produced by the uprush of gas, and that the pipes of volcanoes are formed in the same way. The dust which is blown away includes little spheres, which are probably fused material. As a name for the masses of rock which crown the summits of such perforations in the earth's crust, "ecphysema" is proposed.

VOLCANIC AGENCIES.

***35. Johnston-Lavis, H. J.—Report of the Committee . . . appointed for the investigation of the Volcanic Phenomena of Vesuvius and its neighbourhood.**

Rep. Brit. Assoc. for 1892, pp. 338–343.

The author states that few additional facts of interest have come to light, but several little problems of purely local geology have been solved. Some of these he draws attention to; they relate to the distribution of the "Museum breccia," the geology of Cuma, and the author's theory of pipernoid structure. Vesuvius has remained inactive, but the old flow of lava which had previously commenced has now reached the escarpment of Somma, and covered up some of the numbers painted on the dykes.

36. Grossmann, K.—The Crater Hverfjall.

The Glacialists' Mag., vol. i. pp. 85–91, plate vi.

This crater, which lies near the eastern shore of Myvatn in the north-east of Iceland, has been described by Preyer and Zirkel, by Baring Gould, and by Thoroddsen. Within it, on the northern side, there is a mound which these authors consider to be due to a later volcanic eruption. The present author, however, thinks that the hill and its ridge are the work of snow, which, by partially filling the crater, has allowed the fragments to slide over it from the southern edge of the crater to their present position.

EARTHQUAKE PHENOMENA.

***37. Johnston-Lavis, H. J.—A new Seismograph.**

Nature, vol. xlvii. p. 257.

Gives an account of an instrument described in an Italian journal.

38. Milne, J.—Earthquakes and other Earth-Movements.

London, Kegan Paul, 3rd edn., 8vo, pp. 367, and a map.

This book is vol. lvi of the International Science series. It commences with a description of the various seismoscopes

and seismographs which have been invented, culminating in the Gray-Milne seismograph.

An earthquake is a wave, not only of elastic compression, but also of elastic distortion, the result, in some cases, being a change of state with or without any change of volume. The period of vibration is denoted by $2\pi\sqrt{\frac{\text{density}}{\text{elasticity}}}$. If the amplitude of vibration varies inversely as the distance from the origin the angle of emergence corresponding to the maximum horizontal displacement is 45°; but if the amplitude varies inversely as the square of the distance it will be 55° 44′. Experiments made with falling weights, rolling spheres, and explosions of dynamite have shown that two sets of vibrations are set up; one, direct from the point of origin to the point of observation, and the other at right angles to this. The direct vibrations travel with greater velocity (in one case 446 ft. per sec.) than the transverse (357 ft. per sec.), and they also die out more rapidly. Both velocities are increased by a greater initial impulse, and at greater distances they tend to equality. The amplitude of vibration diminishes directly as the distance at first, but at a slower rate at greater distances. If three stations be taken at different distances from the centre of impulse, and the mean acceleration of earth particles at these stations noted, it is found that the curve of intensities approximates to a rectangular hyperbola, to which the lines of distance and acceleration are asymptotes. The area between the curve and the asymptotes represents the whole energy of the shock. The experiments of the author confirm those of Mallet and Abbot in showing that the initial vertical motion is more rapid for a greater explosion, and that the velocity decreases with the distance from the origin; and the same is true for the normal vibration. In actual earthquakes several shocks of different periods and amplitudes are usually combined, but some are very small; vertical ones being often not more than 2-3 mm., while horizontal ones are as many inches. The observations of the author and of others show that—1. Different earthquakes, though travelling across the same country, may have very different velocities, varying from hundreds to thousands of feet per second. 2. The same earthquake usually travels more quickly near the origin than farther away. 3. The greater the intensity of the shock the greater is the initial velocity.

With regard to the effects on buildings, etc., it is observed that the greatest effects take place in walls at right angles to the direction of the shock. If the motion be vertical, unequal weights will be unequally lifted, so that vertical fissures will be formed which will be largest at the base. If a wall be moved horizontally the base will travel fastest, and the fissures produced will be widest at the top. If the wave emerge at a high angle the fissures will be transverse to it and largest on the side nearest to the source. When a building has once been cracked further

shocks in the same direction will not crack it more unless they are larger than the previous ones. The windows of houses subject to horizontal shocks should be arranged quincuncially. In many cases the earthquake causes the building to rock like an inverted pendulum, and even to topple over. Now different parts may have different vibrational periods, and if such be bound together they are liable to be torn asunder, but parts of equal vibrational period will be strengthened by union. The best form of house to resist an earthquake shock is either the light wicker-like style adopted by the Japanese, or a one-storied building resting on balls and with the chimneys detached. Observations as to whether hard rock or soft soil forms the best foundation are contradictory.

All parts of the area affected by an earthquake are not equally shaken, for any portion of a mountain out of the line of propagation will be *in shadow* for direct shocks. Elsewhere there are *earthquake-bridges*, where no shock is felt: these are supposed to be due to some kind of internal reflection of the wave.

Details are next given on the well-known phenomena of cracks in the ground and their results; and of shocks originating beneath the sea.

Next the determination of the point of origin is discussed. We cannot always assume that the motion has only been normal; on the other hand a single shock may cause rotation if it be not along the line joining the centre of gravity with the pivot; in fact, the direction of rotation indicates on which side of this line the direction of propagation lies. In artificial earthquakes it is found that the maximum motion of the ground is towards the point of origin. Four methods are given for determining the position of the epicentrum from time observations—1. The method of straight lines. By this method points are taken at which the shocks were synchronous: these are assumed to be equally distant from the epicentrum, which is thus the centre of the circle passing through them, *i.e.* pairs of such points are joined and the straight lines bisecting the joins at right angles pass through the epicentrum. 2. The method of circles. In this three points are taken at which the shock was not synchronous. Then assuming that the velocity of propagation is constant, the epicentrum is such a point that the difference between its distance from the point where the earliest shock was felt and that from either of the others, is proportional to the time intervals between the shocks. Hence with the two later shocked points as centres and radii equal the time intervals describe circles; the circle which touches these and passes through the third point is the epicentrum. 3. The method of hyperbolas. This allows for different velocities in different directions. Taking two stations, the epicentrum is such a point that the difference of its distances from these two stations is equal to the space travelled by the shock in their neighbourhood, during the

interval between its arrival at the two stations. It will therefore lie on a known hyperbola, of which the two stations are foci. Another hyperbola being determined in the same way, one of the intersections of these two curves must be the epicentrum, or, if the surfaces of hyperboloids had been employed, the seismic focus. 4. The method of co-ordinates. In this the times of shock at five places must be known. The distance of each of these from the seismic focus equals the velocity (assumed constant) multiplied by the time interval between the primary shock and its arrival. Expressing this in symbols we get five equations involving the three co-ordinates of the seismic focus, the velocity, and the time of the original shock, all of which can thus be found. All these methods have been tried in the case of a well-known shock in South America, and have given closely concordant results.

For determining the depth of the seismic focus, Seebach's method is explained. For this the epicentrum and the time of arrival at three stations in a straight line with it, must be known. At each of these erect a perpendicular proportional to the time of propagation from the epicentrum to that station. These will lie on a hyperbola, of which the centre is the seismic focus. The depth may also be determined by Mallet's method, by the angles of emergence, as shown by the cracks.

In all these investigations it is assumed that the focus is a point, that the propagation is direct, and that the velocity is constant, none of which assumptions is probably correct, so that a wide margin must be allowed. It is thus by no means certain that 30 miles is a maximum depth.

The next three chapters deal with the distribution of earthquakes in space and time. Many certainly originate beneath the ocean and arrive synchronously at various points along the coast. As they are probably influenced by cosmical causes they may have been more abundant in the past. In any one district subject to them periods of maximum frequency may be noted. In the northern hemisphere they appear to be more numerous in winter, but this is not the case in the southern hemisphere. They are more numerous when the moon is in perigee or in sysygy—and there may be some connection between their occurrence and meteoric swarms—but the idea that they more often occur in the night time is probably due to their being then more noticeable, as it is not confirmed by the records of automatic instruments. In Japan, at least, they show no connection with the state of the barometer.

As to the causes of earthquakes, the author concludes that the majority are probably due to faulting and a few to explosions at volcanic foci. The moon, the seasons, etc., can only be regarded at best as determinative.

In the last three chapters many details are given of the constant earth-tremors which have been observed by means

of the microphone and otherwise, of the pulsations of long period, and of oscillations in the earth's crust.

39. Davison, C.—On the annual and semi-annual Seismic Periods.

Proc. Roy. Soc., vol. liv. pp. 82–85.

General catalogues, such as those of Mallet and of Milne, are made use of, and the numbers and amplitudes recorded are so combined as to bring out, first the annual, and second the semi-annual periods. The examination seems to lead roughly to the following conclusions: (1) In both periods the amplitude is greater for slight than for strong shocks. (2) Two classes of slight shock have an annual period, the stronger having their maximum in winter, the weaker in summer. (3) Both have the same maximum epochs during the semi-annual periods. (4) The maximum epoch, as regards the annual period, occurs in winter in both hemispheres [*cf.* No. **38**]. (5) The maximum epochs in the semi-annual periods occur in February to March and in August to September for the southern hemisphere, and a month earlier for the northern. (6) In fifteen cases the amplitude of the semi-annual period exceeds that of the annual period. Considerations are stated which lead to the probability that the increase of barometric pressure may be related to the frequency of shocks.

40. Davison, C.—On the British Earthquakes of 1892.

Geol. Mag., Dec. 3, vol. x. pp. 291–302.

The following is the list, arranged according to localities:—

Ardochy, Feb. 23 (2), April 3, Oct. 24, and Nov. 18.

Loch Broom, Mar. 4.

South-West Cornwall, May 16, 17.

Pembrokeshire, Aug. 17, 18 (7), 22.

The Lock Broom earthquake was of intensity V., epicentrum six miles N. 26° W. of Ullapool. The boundary of the disturbed area corresponds to an isoseismal of intensity IV., which extends 28 miles, from N. 30° W. to S. 30° E., and 17 miles in the transverse direction. The sound area was approximately coincident with this. If the earthquake were due to faulting the hade of the fault must be S.W.

The South-West Cornwall earthquakes were two, separated by an interval of three hours. The intensity of the first shock was IV., epicentrum 1½ miles N.E. of Wendron; the boundary was nearly circular, 12½ miles in diameter. The second shock had an intensity V., epicentrum 3½ miles N. 150° W. of Helston. The area enclosed by the isoseismal of intensity IV. was 20 miles long from east to west, and 15 miles broad. The sounds commenced before and after the shock. If the earthquake were

due to faulting the fault must run east to west, hade to the south, and meet the surface north of the epicentrum. It probably extended 2½ miles on either side of this, and died out more gradually towards the west. The second shock was itself a double one, the latter part being probably a repetition of the original impulse. The slip must have increased the downthrow of the fault.

41. Lowe, E. J.—Earthquake Shocks.

Nature, vol. xlvii. p. 247.

Records shocks felt at Severn Junction Station, on June 3rd.

*42. Hull, E.—The Earthquake Shocks of 17th August, 1892, in the British Isles, and in Central France a week later.

Trans. Manchester Geol. Soc., vol. xxii. pp. 197–199.

This shock is said to have been felt along a line from L. Foyle by Dungannon, Dundalk, Killiney, St. David's Head, Pembroke Docks, and the Bristol Channel, to Devon and Cornwall. "The above appears to be an axial line." The author then remarks that this line, if continued, passes by Auvergne, where there was a shock a week later, and then to Etna, which was in eruption about the same time. He thinks these are all connected phenomena. "As regards the immediate cause of the earthquake, it seems probable that the occurrence of a new moon three days before may have precipitated the shock, as suggested by R. S. Ball."

43. Anon (J. B. R.).—Earthquake in Devon.

Rep. and Trans. Devonshire Assoc. vol. xxv. pp. 175–177.

Records an earthquake felt in August, 1892. It produced a tidal wave up the Yealm, and also at Kingsbridge, and shocks were felt at Newton Abbott, Torrington, Appledore, Lifton, Ashwater, Tavistock, Thorverton, and Princetown.

44. Horne, J.—On Earthquakes.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 404–407. (Read in 1888.)

This paper was read shortly after the occurrence of an earthquake at Inverness on February 2, 1888. It is noted that it happened in a season of heavy rainfall and decreasing barometric pressure. Notes of the experiences of several persons are given. It extended in one direction to Ardnamurchan, and in another to Edinburgh, but only did damage at Fort William; but the earliest of the shocks was felt at Inverness at 5.1 a.m.; it reached Fort William at 5.3 a.m., Ardnamurchan at 5.5 a.m., and Banff at 5.9 a.m. "It is highly probable that the phenomena may have

been partly due to displacement of the strata in the neighbourhood of Loch Ness."

45. Anon.—The Earthquake in Zante.

Nature, vol. xlvii. p. 620.

Quotes an account published in the Mediterranean Naturalist.

46. Egerton, R. W.—Effects of Earthquakes on North-Western Railway, India.

Engineering, vol. lv. pp. 698, 699.

After the earthquake a long fissure appeared running in a north and south direction along the western side of the Khojak, and corresponding to a previous line of springs, which indicate a line of fault. The earthquake has brought the land on the two sides of the fissure closer together by 2 ft. 3 in., as measured by the puckering of the railway lines where they are crossed by it. Three views and two plans are given.

47. Davison, C.—Note on the Quetta Earthquake of December 20, 1892.

Geol. Mag., Dec. 3, vol. x. pp. 356–360.

The details recorded are from the notes of R. W. Egerton.

The earthquake took place along a line parallel to the Khojak range, and in about the centre of its line of action it traverses the Shalabagh railway, whose rails it twisted into a loop, of which photographs are given. The distance between the undisturbed parts was actually shortened, so that there was a permanent displacement of the earth's crust. The line of disturbance is along an old fault, which is now a fissure. As the sides were made to approach the fault must be a reversed one, and it is the side next the Khojak range which has moved outwards.

48. Milne, J.—Twelfth Report of the Committee . . . appointed for the purpose of investigating the Earthquake and Volcanic Phenomena of Japan.

Rep. Brit. Assoc. for 1892, pp. 93–129.

First we have a catalogue, with observations, of 135 earthquakes which took place in Japan between May 1, 1891, and April 30, 1892. Next come the details of 630 earthquakes in 1888, and 930 in 1889. If in all these we take note of the intensity, the fact of seismic energy being greater in winter than in summer is brought out more clearly. Many of the secondary shocks, which spread over a period of several months, are only the outcome of a single primary disturbance. Continuous observations by means of a pendulum tromometer, of which a description is given, have been made, with the result

that earth tremors are found not to have the character of vibrations produced by falling weights, but are rather wave-like pulsations, irregular in period, and producing changes of level. From their relation to the amount of barometric pressure, it is thought that they may be due to sudden changes in this over large areas. There is also some evidence that their amount may be affected by variations in the temperature or moisture of the ground.

The overturning of columns appears to depend chiefly on the relation of the height to the area of the base, and from observations on similar columns the amount of acceleration in each earthquake may be determined. As such columns are most liable to snap at the base, this should be made stronger than usual in earthquake countries.

A long account is then given of the great earthquake of October 18, 1891, a general description of which, with photographic illustrations, has been published in a work entitled "The Great Earthquake in Japan," but the mass of information collected has not as yet been thoroughly dealt with. The immediate cause appears to have been the formation of a great fault which can be traced on the surface for a distance of 40–50 miles, and which had a surface-throw of 20–30 ft., though the probable underground displacement was much greater. There were also lateral displacements and a compression of the ground amounting in some instances to 30–48 ft. The great shock was followed by about 3000 minor shakings, the results of which have been landslips and depression of mountains. In one case great undulations were seen travelling along a street.

49. Davison, C. — Report of the Committee . . . appointed to consider the advisability and desirability of establishing in other parts of the country observations upon the prevalence of Earth Tremors similar to those now being made in Durham in connection with coal-mine explosions.

Rep. Brit. Assoc. for 1892, p. 343.

The committee has only as yet ascertained what instruments are in use for the purpose, a few of which they mention, and promise a detailed description of all of them next year.

50. Milne, J.—On Earth Pulsations and Mine Gas.

Colliery Guardian, vol. lxvi. p. 59, and Trans. Fed. Inst. Mining Eng., vol. v. pp. 203–218.

By the use of extremely light tromometers, in Japan and elsewhere, "the writer concludes that areas of the earth's surface are at times thrown into a series of flat wave-like undulations." These are most frequent in winter, and are possibly due to fluctuations of barometric pressure. They are connected in their times of greatest frequency with escapes of fire-damp.

EARTH MOVEMENTS.

*51. Fisher, O.—On the Thickness, Expansion, and Resulting Elevation of Marine Deposits.

Geol. Mag., Dec. 3, vol. x. pp. 254–262.

A given area of the earth's surface is conceived of, in effect, as the surface of a mass floating on a liquid substratum. On this surface a deposit is supposed to take place, which will have the effect of pushing the mass further down into the liquid and so making room for more deposit on the top. A relation may thus be obtained between the amount of deposit and the effective shallowing of the sea, and hence we can find the amount of deposit necessary to fill up a sea of any given depth, allowing for the sinking, *pari passu*, of its bottom. If the density of the liquid substratum be taken as 2·96, the density of the solid crust as 2·65, that of the deposit 2·5, and that of the sea 1, it is shown that every foot by which the sea is shallowed will require 4·26 ft. of deposit. If, however, the sinking of the crust brought about by the increase of its load causes a melting of the under side, so that the thickness of the solid crust remains constant, then a still greater thickness of deposit, viz. 10·9 ft., is required for every foot of shallowing. It is then calculated how much such a deposit would expand by being depressed into regions of greater heat; and assuming that the mass in question is prevented from expanding horizontally, so that its cubical expansion all takes place in an upward direction, and assuming such expansion for rock to be ·0000215 for 1° Fahr., and the temperature of the liquid substratum to be 2000° Fahr., the rise which would take place if a sea one mile deep were first filled up by 4·26 miles thickness of sediment and only afterwards began to expand, would be 475 ft. If the larger figure of 10·9 be taken, and the constant thickness of the crust be assumed to be 20 miles, the rise would be 1800 ft. Hence it is concluded that, as all the assumptions made are too favourable and yet the result is insignificant, this expansion cannot be appealed to alone as the cause of the elevation of lofty plateaux.

*52. Reade, T. M.—The Genesis of Mountain Ranges.

Natural Science, vol. iii. pp. 371–378.

Professor J. Le Conte dealt with this subject in his Presidential address to the American Association for the Advancement of Science, and the author here discusses his conclusions. Amongst these is the distinction between a formal theory and a causal theory of mountain-building. Le Conte's formal theory is that mountain materials are always laid down on marginal sea-bottoms, which were afterwards squeezed up by lateral pressure along the lines of easiest yielding. which is the line of maximum sedimentation, and which thus becomes the line of greatest

hydrothermal metamorphism and of greatest elevation. The author points out that though this theory is called formal, it involves "causes." He agrees with three principles: 1. That mountains correspond to areas of greatest original sedimentation; 2. that the latter is the cause and the former the effect; 3. that the isogeotherms rise in consequence: but Le Conte adopts the contraction theory of mountain elevation, which the author claims to have shown to be inconsistent with the conditions of strain and stress within the earth which he considers to have been demonstrated—conditions which show that the pressure required to produce the known effects should be within the folded area, whereas for the contraction theory the pressure is external to it. With regard to his own theory, the author reaffirms his contention of No. 43, 1891, that the "sediments neither abstract heat from below nor from the sides, but they conserve and utilize what would otherwise be lost." He also lays stress on the fact that the expansion would not only be vertical but also horizontal—in fact, cubical; and that the successive expansions would be cumulative and could never be reversed.

53. Anon.—Theories of the Origin of Mountain-Building.

Nature, vol. xlviii. pp. 551–554.

This is an abridged account of Le Conte's address to the American Association for the Advancement of Science. Lateral pressure is considered to be, in all cases except monoclinal flexures, the proximate cause of mountain-building. The contraction theory, with the objections to it, Reade's expansion theory, Dutton's isostatic theory, and Reyer's gliding theory, are successively passed in review, and of them all the contraction theory is thought to be the best.

54. Wells, H. G.—The making of Mountain Chains.

Knowledge, vol. xvi. pp. 204–206.

Alludes to the theories of Mellard Reade, Lapworth, and Reyer, and thinks there may be some truth in them all.

***55. Browne, R. G. M. — Astronomical Influence in Geological Evolution.**

Westminster Review, vol. cxxxix. pp. 430–446.

"Showing that the dry land is an evolutionary effect produced by astronomical causes and not by subterranean upheaval."

***56. Suess, E.—Are great Ocean Depths permanent?**

Natural Science, vol. ii. pp. 180–187.

The true origin of ocean basins is the sagging down of smaller or greater portions of the crust, caused by the pro-

gressive diminution of the planet's radius. The newly formed depth has to be filled by part of the existing volume of oceanic water, which being drawn from other parts causes the apparent step-like rising of coast lines. The Pacific is outlined by mountain folds, but the Atlantic and Indian oceans are only very partially so, and these constitute two types of oceanic regions. A mass of land against which mountain folds have been dammed back is called a "vorland." Such are the Indian Peninsula and the Aleutian arch. In front of this a valley is formed, as the African desert before the Eastern Atlas, etc., and in this way there is an analogy between the Ganges valley and the Tuscarora depths in front of the arch of Japan and the Kurile Islands. This view does not accord with the idea that the great ocean depths are either very old or permanent. On the general question he remarks that the Old Red Sandstone and the Wealden are fresh-water deposits which are not limited by the present coast lines, and there is no proof that the continents which produced them were limited by the present 1,000 or 2,000 fathom line. Near the south-west corner of Asia Minor, the "Pola" has found a depth of 3,591 metres, yet fresh-water Pliocene conglomerates pass over from the continent to the island of Rhodes. In the Himalayahs and parts of Central Asia the thickness of the deposits is from 12,000 to 14,000 ft., showing that a great and deep ocean has been incorporated into the continent, and that its deposits now form part of the highest mountain ranges. This ocean he calls the "Tethyan." The Lower Miocene of the Mediterranean area extends far beyond the present limits of that area, even as far as Persia; and the great salt deposits from Wieliczka to Persia are of later date, showing later sagging. The occurrence of European (*i.e.* Mediterranean) molluscan types in South America, and of corals of the Gosau type in the West Indies, show that present coast lines may be only interrupted portions of a line which once stretched across the present Atlantic.

***57. Mill, H. R.—The Permanence of Ocean Basins.**

The Geographical Journal, vol. i. pp. 230–234.

The author notices the discussion which has taken place on this subject in Natural Science, and leans towards the view of the permanence of ocean basins. In illustration he gives a map showing the mean sphere level as far as it can be made out, marking in black all the oceanic areas whose bottom lies below this level, which corresponds nearly to the abyssmal area. Continents have been gradually evolved, and oceanic areas are those in which subsidence has predominated.

***58. Jukes-Browne, A. J.—The Geographical Evolution of the North Sea.**

Contemporary Review, vol. lxiv. pp. 704–712.

The author commences with Cretaceous times, and shows the distribution of land and sea during the Eocene and Pliocene periods, in the latter of which the St. Erth beds are considered to have been deposited in an arm of the sea distinct from the East Anglian. He states that the North Sea had no existence till after the period of the Coralline Crag, and its development after that accounts for the coming in of Arctic species in the overlying deposits. It was again restored to dry land in Glacial times, when it was watered by an extension of the Rhine, and the present Dogger Bank was above the sea. Since this period there has been constant depression.

***59. Jukes-Browne, A. J.—The Origin and Classification of Islands.**

Natural Science, vol. ii. pp. 188–193.

The author contests the dictum that the absence of an indigenous mammalian fauna proves an island to be "oceanic," or that any hard and fast line can be drawn between these and "continental" islands. The absence of mammalia may have been brought about by the submergence and re-elevation of the island, though Dr. Wallace doubts whether any such case is known. The author, therefore, quotes Barbadoes, where there are beds showing submergence, and therefore re-elevation now. The Seychelles have Amphibia, New Caledonia stratified deposits, and New Zealand land-shells; and these thus constitute an intermediate type of island.

A. R. Wallace, pp. 193–194, says that these conclusions are founded exclusively on islands situated upon the margin of the continental area, and do not affect his *broad* generalizations.

60. Anon.—The Disaster at Sandgate.

The Builder, vol. lxiv. pp. 185, 186.

Gives an account of the strata present in the district, and attributes the landslip to the sliding of the Hythe beds over the Atherfield clay, supplemented by the foundering of the Sandgate beds themselves.

***61. Blake, J. F.—The Landslip at Sandgate.**

Nature, vol. xlvii. pp. 467–469.

The base rock of this district is the Hythe limestone, which is seen in three places along the shore, all showing the same direction of dip, but the strikes not coinciding, a disposition which is taken to indicate the existence of two faults. The beds immediately above the Hythe limestone are "Sandgate" clays, which may be traced on either side of the town. The boundary of the disturbed area exactly corresponds to the area of exposure of these Sandgate beds. It is concluded that the landslip is

wholly due to the motion of the soft Sandgate beds, where they are unprotected by the overlying hard bands of the Folkestone beds. The slipping is shown by the carrying forward of the sea-wall and by the lifting up of the clay on the foreshore. These changes entirely cease where the Hythe limestone protects the foreshore.

62. Topley, W.—The Sandgate Landslip.

The Geographical Journal, vol. i. pp. 339–341.

The town of Sandgate is built on an old landslip of the Sandgate beds, and the recent slip is only a small movement in an old slip. Small movements occurred in the Atherfield clay at Hythe at the same time. The special local cause was probably the excessive rainfall of 4·3 inches in February. The area of slipping was 2775 ft. long by 700 ft. broad, with 300 ft. additional on the foreshore; the greatest vertical movement was 10 ft. The rocks on the shore were slightly moved, a bed of clay being ridged up about 4 ft. This movement of the rocky Hythe beds, and of the clay lying near, was probably due entirely to pressure from the moving mass of Sandgate beds. To prevent the recurrence, deep drains must be carried along the back of the undercliff. It is possible that the loss of shingle on the foreshore, owing to the erection of groynes at Hythe, may have had some effect, as the slips took place at low-water.

*63. Blake, J. F.—The Sandgate Landslip.

The Surveyor, vol. iii. pp. 199–201.

Landslips are periodic in their occurrence, the result of one having to be cleared away before another can occur on the same spot. The present landslip is confined to the western side of a small stream, here called the Enbrook. The main crack may be traced from near the Military Hospital to this brook; the whole area affected was less than 30 acres. The solid band of limestone on the shore is quite unaffected, but above this the clay has been squeezed down, bending the groyne into an S-like curve so as to shorten it by 36 inches, and beyond this the clay is forced up into a mound on the sea-shore. In the main road, east of Wellington Terrace, the ground has been raised. Thus the slip is a simple slide forward of the clays over the surface of the hard limestone, thus forcing up the lower end. This limestone is repeated further east by a fault, and the same phenomena there recur, *i.e.* the eastern end of the disturbed area has been raised and the street narrowed by a foot, and the sea-wall has been forced 12 ft. forward. The Sandgate beds which have given way consist of soft clay and loose sand. They are not continuous from where last seen, at Mill Point on the east, owing to another fault. Where they have not slipped in the eastern part of the town they are considered to have been

covered by previous slips of the hard Folkestone beds over them [but on this *see* No. **64**]. The immediate cause of the landslip is the draining into the Sandgate beds of excessive quantities of water out of the high land above, which consists of very porous rocks, and this may be prevented in future by a deep drain carried along the upper boundary of the disturbed area.

64. Topley, W.—The Landslip at Sandgate.

Proc. Geol. Assoc., vol. xiii. pp. 40–47.

An account of similar landslips on the coast of East Kent is just given, and then an outline of the geology. The Hythe beds seen on the shore between Folkestone and Sandgate are considered to change their dip where not seen and to go out to sea, and then return on the west side without any fault. The areas east and west of that which have slipped have also Sandgate beds on the surface, and the reason that no slip has taken place in them is that they had been previously drained. The slip was 920 yards long by 233 yards broad, and the maximum vertical movement was 10 feet. On the shore the sea-wall and groynes have moved forward, the latter for a maximum of 18 inches.

65. Martin, E. A.—Some Notes on the Sandgate Landslip.

The Field Club, vol. iv. pp. 83–85.

A rather general discussion of the matter, ascribing the proximate cause to the blowing up of the Benvenue, the arrangement of the strata aiding the action.

66. Hutchinson, P. O.—Landslip at Sidmouth.

Rep. and Trans. Devonshire Assoc., vol. xxiv. p. 174.

This was a fall of the sandstone at the High Peak, at the spot where, on the occasion of a previous fall, the Labyrinthodont was afterwards discovered.

GENERAL PHYSIOGRAPHY.

67. Ulyett, H.—How Great Britain became an Island.

Proc. Folkestone Nat. Hist. Soc. for 1890, pp. 17–27 (1891).

A general lecture, commencing the account with the Cretaceous period. The final separation was due to depression.

68. Deeley, R. M.—Cirques.

The Glacialists' Mag., vol. i. pp. 109, 110.

The author argues for the erosive power of ice in a cwm, by comparing it to lead loaded with grains of emery wearing away steel by rubbing, and illustrates the supposed method

of formation of a lake in a cirque by landslips on an embankment.

69. Miller, H.—The Sutors of Cromarty,—a Chapter in pre-Glacial Geology.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 131–134. (Read in 1885.)

These rocks are considered to have had the channel between them excavated in pre-Glacial times by the river Conon. The gneiss of which they are composed was at that time covered by the Old Red Sandstone.

70. Miller, H.—The Black Rock of Novar.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 308, 309. (Read in 1887.)

This Black Rock is a deep gorge in the midst of Old Red Conglomerate, which is due to erosion by the stream now running in it, which began to run in pre-Glacial times, then changed its course, and after the deposit of the Boulder-clay re-cut this new gorge.

71. Cuttriss, S. W.—The Parallel Roads of Glenroy.

Trans. Leeds Geol. Assoc., part viii. pp. 24–33.

The author gives an account of a visit to the district and a summary of the views of Tyndall and Jamieson, with which he generally agrees.

***72. Shone, W.—The cause of Crateriform Sand-Dunes and Cwms.**

Geol. Mag., Dec. 3, vol. x. pp. 323, 324.

The author thinks that the crater-like depressions on the summits of some dunes is due to the sinking in of the rain, carrying sand with it, and that even the cwms of Cader Idris are due to the same agent, combined with subaerial denudation.

***73. Cadell, H. M.—A Map of the Ancient Lakes of Edinburgh.**

Trans. Edinburgh Geol. Soc., vol. vi. pp. 287–296.

The ancient coast line is represented by the 25 ft. beach, and the following lochs are represented: Gorgar, Costorphine, Burgh, Holyrood, Craigcrook, Lochend, and Duddingston. Gorgar Loch, south-west of Costorphine, was in existence last century. Costorphine Loch was of considerable size, stretching E.N.E. from Costorphine to the Caledonian Railway station, and southwards to Gorgie. It was not entirely reclaimed till 1837. The plants which formerly inhabited it are recorded in

No. **168**, 1892. Burgh Loch occupied the present site of the Meadows, and was not entirely reclaimed until 1840. Holyrood Loch surrounded the present palace, and its former existence is only known by geological observations. The following section has been determined by boring:—

		ft.	in.
	Forced material at surface	3	2
Lacustrine	Yellow clay	2	4
Lacustrine	Peat	3	0
Lacustrine	Marl	9	0
Lacustrine	White and brown mud	2	6
Lacustrine	Blue and red clay	1	9
Lacustrine	Rough gravel	4	6
	Clay and small stones	5	6
	Blue clay	7	7
	Depth to rock..	39	4

Craigcrook and Lochend Lochs are small, and there is not much change in them. Duddingston Loch was once much larger, and extended to the station and to Inch House, along the 150 ft. contour line. The old tarn at Hailes End Quarry shows an interesting section containing a one-foot bed of muddy silt, with rootlets and layers of leaves of Arctic plants and frequent remains of the Arctic *Apus fluviatilis*.

***74. Cadell, H. M.—Geological Changes wrought by Man with the Forth Basin.**

Trans. Edinburgh Geol. Soc., vol. vi. pp. 275–286.

Mining for coal and oil shale has caused sinking. Blairdrummond and other mosses have been reclaimed by washing the peat away into the Forth, and the flat foreshores of the estuary have been covered by mine rubbish and also reclaimed by warping, as between Kincardine and Kennet Pans, on the east of Kincardine Pier, and at Grange, Bo'ness, by the author.

***75. Cadell, H. M.—Some Ancient Landmarks of Midlothian.**

Scottish Geogr. Mag., vol. ix. pp. 302–312, with a map.

The same information as in No. **73**.

STRATIGRAPHICAL AND STRUCTURAL PHENOMENA.

***76. Hunt, A. R.—The Pebble-Ridge at Westward Ho!**

Geol. Mag., Dec. 3, vol. x. p. 477 and p. 526.

The larger pebbles of this ridge often have a removable coat, one-sixteenth of an inch thick, and another inside that. These can be traced in all their stages from rectangular blocks, so that

the structure is secondary, and the author thinks it is due to the impact of one against the other. In the second paper he hastens to acknowledge Townsend Hall's priority of observation.

77. Howe, J. A.—Slickensides.

Nature, vol. xlviii. p. 315.

In a claypit at Longcliff, Derbyshire, a mass of rock broke off and slid down over some clay. It left a polished, striated, and blackened surface on the clay.

78. Church, J. A.—The Cause of Faulting.

Colliery Guardian, vol. lxv. pp. 312, 313.

Read before the American Institute of Mining Engineers. The author expresses the ordinary law of faults thus: "The foot-wall has risen in most inclined faults." He draws attention to the more rapid rate of decrease in the amount of downthrow at the two ends in short faults, as compared with long ones. In the case of the former, *i.e.* faults from 1,000 ft. to 2,000 ft. long, the cause of their production cannot be a general one, as it cannot be shown how the action of such a cause can be concentrated in a single line. Nor is the usual reference to the greater breadth of the wedge at the base considered satisfactory. The formation of the crack and the displacement of the sides are considered to belong to different periods. The fissure is produced by simple compression; it is, in fact, a cleavage crack, but "why a force which acts presumably with equal power through the whole substance of a rock should concentrate its effects on one or on a few lines is beyond our present comprehension. We observe the fact, however." The dislocation is produced by the shortening of the fissure, *i.e.* by its ends being brought nearer together, one side becoming a synclinal and the other an anticlinal, or both sides becoming anticlinals or synclinals, but the maxima of the two not coinciding.

***79. Lomas, J., and Dwerryhouse, A. R.—On some Faults exposed in Arno Quarry.**

Proc. Liverpool Geol. Soc., vol. vii. pp. 118–120, with a plate.

Details are given of these faults; and the conclusions of the first author in No. **65**, 1892, regarding the connection between the direction of the fault and the angle of slickensiding are said to be confirmed.

***80. Harker, A.—The use of the Protractor in Field Geology.**

Sec. Proc. Roy. Dublin Soc., vol. viii. pp. 12–20.

The author advises the use of a rather long form of protractor, on which are marked two sets of angles; in one

set the middle point of the protractor corresponds to o°, and in the other to 90°. The points of subdivision thus form tangent and cotangent scales, if the breadth of the protractor be taken as unity. If, again, we use a scale of equal parts, whose unit is also the breadth of the protractor, and place one end on the radiating point of the protractor, and lay it across so as to intersect the opposite side, its divisions give a scale of secants and cosecants. Thus lines are made to represent angles as well as ratios, and by this means many problems may be solved graphically. Eighteen examples of such problems are given, of which the following is a sample:—

"XV. Given the width of the outcrop of a group of beds in level ground, to find the depth which they will occupy in a vertical boring.

"The ratio of the depth to the width of outcrop is the tangent of the angle of dip (supposed known). Place the edge of the simple scale along that of the protractor, the zero points of the two coinciding. Take the angle of dip on the tangent scale, and read off the corresponding number on the simple scale. This is the ratio required."

MISCELLANEOUS.

***81. Dawson, Sir J. W.—Some salient points in the Science of the Earth.**

London: Hodder and Stoughton, 8vo, pp. 493.

This work is stated to "contain much that is new, and much in correction and amplification of that which is old, and is intended as a closing deliverance on some of the more important questions of geology on the part of a veteran worker." It consists of eighteen more or less popularly written essays, each one being dedicated to the memory of some deceased geologist or naturalist. The subjects are the following: world-making; the imperfection of the geological record; the history of the North Atlantic—practically the author's Presidential address in 1886; the dawn of life, *i.e.* the story of *Eozoon* considered as an animal; what may be learned from *Eozoon*—carrying the matter further, a word-picture is given of *Eozoon* as a solitary primeval animal; the apparition and succession of life forms—the author discusses homotaxis, peculiar life forms, and various other interesting subjects, and formulates eleven conclusions, including the maintenance of "creation against materialistic evolution," and declaring that "the introduction of new species of animals and plants has been a continuous process, not necessarily in the sense of the derivation of one species from another but in the higher sense of the continued operation of the cause or causes which introduced life at first," that "allied species have made their appearance at once in various parts of

the earth," and that "the drift of 'palæontological' testimony is to show that species come in *per saltum*"; the genesis and migration of plants, particularly referring to Arctic fossil plants; the growth of coal; the oldest air-breathers; markings, footprints, and fucoids; pre-determination in Nature; the great Ice Age—the author does not believe in ice-sheets, and says "the Scandinavian boulders scattered over the plains of Great Britain must have been water-borne"; causes of climatal change—he cannot believe the astronomical theory, as it places the Glacial epoch 80,000 instead of 8,000 years ago, but adopts that of geographical change; the distribution of animals and plants as related to geographical and geological changes; Alpine and Arctic plants in connection with geological history; early man—the author considers that the close of the Glacial epoch should be regarded as the end of the Pleistocene, and that only later deposits of "Anthropic" age are certainly known to contain relics of man [uniting this with a Glacial period ending 8000 years ago, the author seems to contend that man is not known to have existed on the earth 8000 years]; the last essay is on Man in Nature.

***82. Geikie, J.—Fragments of Earth Lore—Sketches and Addresses, Geological and Geographical.**

Edinburgh, Bartholomew, 8vo, pp. 428, with six plates.

A reprint of a number of the author's previous writings, viz.:—

Geography and Geology, 1886.
The Physical Features of Scotland, 1885.
Mountains: their Origin, Growth, and Decay, 1886.
The Cheviot Hills, 1876.
The Long Island, or Outer Hebrides, 1879.
The Ice Age in Europe and North America, 1884.
The Intercrossing of Erratics in Glacial Deposits, 1881.
Recent Researches on the Glacial Geology of the Continent, 1889.
The Glacial Period and the Earth-Movement Hypothesis, 1891–2 [No. **185**, 1892].
The Glacial Succession in Europe, 1892 [No. **247**, 1893].
The Geographical Evolution of Europe, 1886.
The Evolution of Climate, 1890 [No. **86**, 1890].
The Scientific Results of Dr. Nansen's Expedition, 1891 [No. **626**, 1891].
The Geographical Development of Coast Lines, 1892 [No. **48**, 1892].

83. Harris, W. H.—Pages and Pictures from Pre-Adamite History.

Fifteenth Ann. Rep. Ealing Micr. and Nat. Hist. Soc., pp. 4–9 [1892].

Report of a lecture. The formations are noted in order as successive pages of the history.

***84. Hull, E. — How the waters of the Ocean became Salt.**

Advance copy from Trans. Victorian Institute.

The general similarity of Palæozoic Mollusca to those of the present shows that the sea has always been salt. Beds of rock-salt are not considered to be evidence of this, as they have probably originated in inland seas, and the composition of the "salt" being said to be not the same as that derived from the evaporation of ordinary sea-water. Some, however, of the American Silurian rocks with marine Mollusca are saliferous. The author does not accept Sterry Hunt's view that the primeval ocean was saturated with acid gases, but expounds the ordinary view that the salt is derived from the action of the primeval atmosphere saturated with chlorine and other gases on the crystalline rocks, the sodium being principally derived from the decomposition of soda-felspars.

85. Proctor, C.—The Atmosphere in the Early Geological Periods.

Trans. Inverness Sci. Soc., vol. iii. pp. 415–417. (Read in 1888.)

The amount of carbonic acid which has become fixed in coal and limestone is 40 times as much as that now existing in the atmosphere. It is hence concluded that there has been a gradual slowing down of the forces of Nature, so that the demand of geologists for enormous periods of time is unnecessary.

86. Geikie, Sir A.—Inaugural Address to the British Association.

Rep. Brit. Assoc. for 1892, pp. 3–26.

Published in Nature in 1892 [*see* No. **5**, 1892].

87. Lapworth, C.—Presidential Address to Section C.

Rep. Brit. Assoc. for 1892, pp. 695–707.

Published in 1892 in the Geol. Mag. [*see* No. **42**, 1892].

88. Geikie, J.—Presidential Address to Section E.

Rep. Brit. Assoc. for 1892, pp. 794–810.

Published in 1892 in Nature and in the Scottish Geographical Magazine [*see* No. **48**, 1892].

***89. Woodward, H. B.—Address.**

Trans. Norfolk and Norwich Nat. Soc., vol. v. pp. 333–363.

Gives a short memoir of T. G. Bayfield; discusses species, zones, the "Cromerian" deposits, *i.e.* the Cromer forest beds, etc., the "Glacial nightmare"; notes *Tellina balthica* in the Aylsham Crag, and concludes with remarks on the Broads and on University Colleges.

90. Markham, C. R.—The Limits between Geology and Physical Geography.

Scottish Geogr. Mag., vol. ix. pp. 633–639, and Geogr. Journal, vol. ii. pp. 518–525. (Read at B. A. in 1892.)

The limit is to be found where human testimony ceases.

***91. Prestwich, J.—The Position of Geology.**

Nineteenth Century, vol. xxxiv. pp. 551–559.

A discussion of the various views of the length of geological time, as held by Uniformitarians and Physicists. Without holding with the conclusions of the latter, the author trusts that in this essay he has "said enough to show upon how insecure a basis the Uniformitarian measures of time and change stand," and speaks of "the dwarfing influence of Uniformitarianism."

***92. Bulman, G. W.—Some fragments of Geological History.**

The Field Club, vol. iii. pp. 49–52, 81–83 (1892).

Notes of ancient opinion on first principles.

***93. Coates, H.—The History of Scottish Geology.**

Proc. Perthshire Soc. Nat. Sci., vol. i. pt. vii. pp. clxviii.–clxxv.

A summary from the earliest to modern times.

***94. Geikie, Sir A.—The Work of Geological Survey.**

Colliery Guardian, vol. lxv. pp. 1145, 1146, and Trans. Fed. Inst. Mining Eng., vol. v. pp. 142–168.

A detailed account of how the work is done.

***95. Cole, G. A. J.—Geology in Secondary Education.**

Natural Science, vol. iii. pp. 332–335. (Read at B. A.)

A claim to have the science introduced into the curriculum of secondary schools.

***96. Woodward, H.—On Fossils applied as Charms or Ornaments.**

Geol. Mag., Dec. 3, vol. x. pp. 246–248.

Notes on ammonites, encrinites, and *Lepidotus* teeth as ornaments, giving the appropriate myths. A figure is given of a "Crapaudine locket," made of two *Lepidotus* teeth fitted base to base so as to leave a cavity in the centre.

***97. Bulman, G. W.—Some Curiosities of Geology.**

The Gentleman's Magazine, vol. cclxxv. pp. 408–415.

A miscellaneous assortment of them.

98. Anon.—Third Report of the Committee . . . to arrange for the collection, preservation, and systematic registration of Photographs of Geological Interest in the United Kingdom.

Rep. Brit. Assoc. for 1892, pp. 290–298.

The photographs collected have now been mounted in Zaehnsdorf self-binding mounts of whole-plate size, fitted with special perforated guards for binding. The following additional photographs have been obtained [*see* No. **68**, 1892]:—

Cheshire, 2. Bunter Sandstone. Breakers.
Denbighshire, 5. Carboniferous Limestone escarpment. Boulder-clay.
Dorset, 6. Luccombe. Purbeck trees.
Durham, 16. Whin Sill. Magnesian Limestone concretions.
Glamorganshire, 9. Penarth beds.
Merionethshire, 1. Granitite intrusion.
Northumberland, 8. Boulder-clay. Coal-measures.
Shropshire, 7. Gloppa sands and gravels.
Yorkshire, 8. Clapham Cave. Whin Sill.
Scotland, 7. Volcanic tuffs, dyke, cliffs.
Ireland, 31. Cliffs, boulders, wind-erosion, dykes, chalk, and basalt.

Also a section of Foraminifera in Denbighshire limestone, and 11 of the microscopic structure of the Taplow chalk.

99. Storrie, J.—On some methods of Photographing the Geological Features of the neighbourhood.

Rep. and Trans. Cardiff Nat. Soc., vol. xxiv. part ii. p. 22.

Suggests that photographs should be taken with standard lenses, etc., which should be preserved, so that the same scene when photographed in future years, under the same conditions, might give evidence of any change in the scenery.

TEXT BOOKS.

100. Anon.—The Students' Column—Geology.

Builder, vol. lxv. pp. 15, 33, 52, 71, 88, 108, 126, 142, 161, 178, 194, 211, 229, 247, 266, 287, 305, 322, 341, 362, 378, 395, 418, 437, 454, 473, 493.

A series of 27 articles on the general subject, from a practical point of view. Between pp. 320 and 321 are given reproductions of photographs of three quarries and two views to illustrate the connection of geological structure with scenery.

101. Aveling, E.—An introduction to the Study of Geology, specially adapted for the use of candidates for the London B. Sc. and the Science and Art Department's Examinations.

London, Swan, Sonnenschein, 8vo, pp. 354, with a geological map.

102. Bonney, T. G.—The story of Our Planet.

London, Cassell, medium 8vo., pp. 592, with 6 plates.

"The plan on which this book has been framed is generally similar to that adopted by Sir Charles Lyell in his great work, 'The Principles of Geology.'" The author has "on one or two points expressed opinions which, just at the present time, are those of the minority (though a large one) rather than the majority of geologists." "In regard to these" he has "had rather exceptional opportunities of forming an opinion.. Chief of these are the physical geography of Britain in the earlier part of the Triassic period; the effects and former extent of glaciers; and the history and age of certain crystalline rocks."

103. Cole, G. A. J.—Aids in Practical Geology.

London, Griffin, 2nd edition, 8vo, pp. 402.

No essential change appears to have been made in this edition. Indeed it would be hard to make any for the better.

104. Geikie, Sir A.—Text Book of Geology.

London, Macmillan, 3rd edition, 8vo, pp. xvi. 1147.

The present edition of this well-known and invaluable work is stated to be "entirely revised, and in some cases re-cast and re-written." Some of the changes, of various degrees of importance or significance, are indicated by the table of contents. Under rock-structures the term "macroscopic" is changed to megascopic, and a section on chemical synthesis is added. In

the descriptions of rocks the order has been inverted, so that now "fragmental rocks" come first. The "massive eruptive igneous" rocks are no longer classified by their principal minerals, but by their relative acidity, and the schistose rocks are for the first time called metamorphic. In dynamic geology an account of the sills and dykes in a plugged vent, and a note on the action of sea-weeds, are added. In structural geology we now have described the alteration of igneous rocks by their surroundings, and the two headings "Regional metamorphism" and "Archæan crystalline schists" have become one with considerable alterations. In stratigraphical geology "Archæan" has been replaced by "pre-Cambrian" and a separate heading used for "pre-Cambrian sedimentary and volcanic groups." Finally "Quaternary or post-Tertiary" is changed to "post-Tertiary or Quaternary."

In the stratigraphical part the table of strata is enlarged and somewhat altered at the base. The term Primordial Silurian and the subdivisions Tremadoc, Lingula Flags, Menevian, and Longmynd, are all swept away, and their place taken by Cambrian with subdivisions Olenidian, Paradoxidian, and Olenellus series, while pre-Cambrian includes Torridonian, Uriconian, Longmyndian, etc. Doubt is thrown on the separate existence of a Laurentian system in Canada. The "Olenellus zone" in Wales is said to comprise "the Harlech and Llanberis group and Pebidian." The Durness Limestone series is removed from the "Silurian" and placed in the "Cambrian."

In the Silurian, Lapworth's classification of the rocks of the southern uplands of Scotland is given, which divides them into Wenlock, Ludlow, and numerous Llandovery groups, and the old account is entirely erased.

105. Jukes-Browne, A. J.—Geology—an Elementary Handbook.

London, Whittaker, 8vo, pp. 248.

This is an abridgment of the author's somewhat larger handbooks [*see* No. **72**, 1892, and No. **104**, 1890].

106. Kayser, E.—Text Book of Comparative Geology.

Translated by B. Lake. London, Swan, Sonnenschein, 8vo, pp. 426.

This book affords a mine of information about the rocks of Europe, with short notices of those of other continents, the English formations being described in their place. The palæontology is illustrated by 70 figures and 73 plates, including 536 fossils. The original work is not simply translated by the editor, but parts are added and changed; but there is no mark by which it may be told which parts are thus due to the editor. A

comparison with the original shows that the statements about our English rocks are for the most part editorial.

107. Roberts, R. D.—The Earth's History—an introduction to Modern Geology.

London, Murray, small 8vo, pp. 270, with 9 plates.

This small volume, being a "University Extension Manual," opens with an expanded table of contents in the form of a "syllabus" to a course of lectures. The book, as a whole, somewhat resembles in character Huxley's "Physiography."

STRATIGRAPHICAL GEOLOGY.

PRE-CAMBRIAN.

***108. Geikie, Sir A.—The Pre-Cambrian Rocks of the British Isles.**

Journal of Geology, vol. i. pp. 1–14.

The author states that the quartzites which lie beneath the bed containing *Olenellus*, in the north-west of Scotland, are basal Cambrian; that the two underlying groups, viz. the Torridonian and the gneisses, are both pre-Cambrian, but they cannot be classed together and should not, therefore, be called by the common name Archæan. The Lewisian gneisses, with the exception of certain rocks near Loch Maree, are all of igneous origin, the separation into distinct layers being due to segregation in the still viscous magma. The Torridon Sandstone in general aspect looks as young as the Old Red Sandstone, but the interval between it and the basal quartzites must have been very long, because the latter overlaps the whole of it and rests upon the gneiss, indicating that the sandstone had been in places entirely denuded away. With regard to the Eastern gneisses, the author states that over many hundreds of square miles the original rock-structures have been entirely effaced and that we have here striking proofs of a stupendous post-Cambrian regional metamorphism; but as to the gneisses themselves, he cannot determine whether they are of the age of the Torridon Sandstone or later than the Durness Limestone. It is, therefore, safest to exclude them from the pre-Cambrian. As to the "Dalradians," he cannot say what their age may be, and they may include any or all of those above described. He considers that "small tracts of gneiss, quite comparable in lithological character to portions of the Lewisian rocks, rise to the surface

in a few places in England and Wales," and cites Anglesey as an example. As to the felsites of Caer Caradoc, "though the evidence is not quite satisfactory, they may not impossibly lie at the base" of the "Longmyndian." He "regards the so-called Pebidian as merely marking the duration of a volcanic period in early Cambrian times."

***109. Hicks, H.—The Pre-Cambrian Rocks of Wales.**

Geol. Mag., Dec. 3, vol. x. pp. 396–401.

This paper, presented to the Geological Congress at Chicago, is "a brief summary of the results obtained," according to the views of the author, "in unravelling the history of the older rocks of Wales during the past thirty years." He wishes the names Dimetian, Arvonian, Pebidian, and Grampian to be used for such rocks as are now admitted to be pre-Cambrian.

110. Hicks, H.—On the Grampian Series (Pre-Cambrian Rocks) of the Central Highlands.

Rep. Brit. Assoc. for 1892, pp. 712, 713.

Published in 1892 in the Geol. Mag. [*see* No. **76**, 1892].

111. Horne, J.—The North-West Succession.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 91–97. (Read in 1885.)

A preliminary account of results now well known.

CAMBRIAN AND SILURIAN.

***112. Blake, J. B.—On two Tunnel Sections in the Cambrian of Carnarvonshire.**

Rep. Brit. Assoc. for 1892, p. 718.

The two tunnels are at the Penrhyn Quarries and at Moel Tryfaen: they are more fully described as part of No. **113**.

***113. Blake, J. F.—On the Felsites and Conglomerates between Bethesda and Llanllyfni, North Wales.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 441–465.

This paper is intended to supply the detailed proofs of two statements made in No. **77**, 1892—1. That the felsites of North-West Carnarvonshire occur in the midst, and not at the base, of the "Cambrian" succession. 2. That the so-called "Cambrian" conglomerates that overlie the highest of these felsites are distinct from those that form part of the Cambrian series,

FIG. 1.—Section along the railway north-west of Llanberis.

and overlie unconformably the members of that series and in particular the purple slates. The proofs are as follows:—

At the extreme end of a tunnel running north-west from the Penrhyn slate quarry, at the bottom of a shaft, a mass of felsite is met with, which corresponds to that which was reported to Sir A. Ramsay many years ago. This is followed upwards by a whetstone or altered slate, and then by a green conglomeratic grit, after which comes immediately the "hard blue" of the slate quarry. Here, therefore, is a felsite and conglomerate immediately beneath the purple slates, and occupying the position of the St. Ann's grit.

The conglomerate which runs from Moel Rhiw-wen to Moel-y-Ci, and which is marked as post-Cambrian on the author's map (*loc. cit.*), is not very clearly seen, and may either be unconformable to the slates, as there supposed, or in the alternative lie immediately below the lowest purple slate, and above the banded series, *i.e.* in the middle of the "Cambrian" succession. In any case it is not on the same horizon as the last described, and is not in connection with any felsite.

A new reading is then given of the well-known section along the mineral line north-east of Llyn Padarn. The chief point here noted is, that the conglomerate described by Prof. A. H. Green as unconformable (Q.J.G.S., vol. xli. 1885) is proved to be so by lying horizontally on a succession of beds differing from one another and standing vertically. A detailed description of the country above the level of the railway is then given. The conglomerate clings to the felsite on the eastern side, shading gradually into reconstructed felsitic material, but it also extends over the surface of the pale slates, and the associated grits form the summit of Y Bigl, there occupying the line of strike of the synclinal of pale slates which is seen in the mineral-railway section. Figures are also given of two spots where these grits are actually seen overlying the pale slates in one case, and in the other lying horizontally at a higher elevation than the pale slates were: the latter are nearly vertical.

A section is next described along the side of the Llanberis Railway, on the opposite side of the lake, being that already described by Mr. G. Maw (Geol. Mag., 1868) [fig. 1]. At the W.N.W. end the conglomerate is seen to succeed the felsite, and has thus been taken to be the base of the Cambrian series; but it is here shown that the felsite comes up again towards

the east, so that the conglomerate is lying on a superficial trough of it, and not between it and the purple slate: on the contrary, this second exposure of felsite is in immediate contact with the purple slate, presenting the perhaps fallacious appearance of being intrusive into it, and with certainly no conglomerate between. Further east the conglomerate comes on again, in this case overlying the purple slate. The beds above the conglomerate have considerable resemblance to members of the true Cambrian series, but they turn up again and form a synclinal, overlying to the east true Cambrian strata, which are again succeeded by a similar conglomerate, which is thus the highest bed exposed in the section. The connection between these masses of conglomerate is then traced on the surface of the country above the railway, where they are shown to unite and to have a general horizontal range. The associated grits are said to have a peculiar crinkly and irregular character, by which, when once appreciated, they can always be recognized. The most easterly mass of conglomerate is isolated from the rest, but in the grounds opposite Glyn Padarn it is seen to lie horizontally over purple slates where these dip towards the east at an angle of 45° [fig. 2].

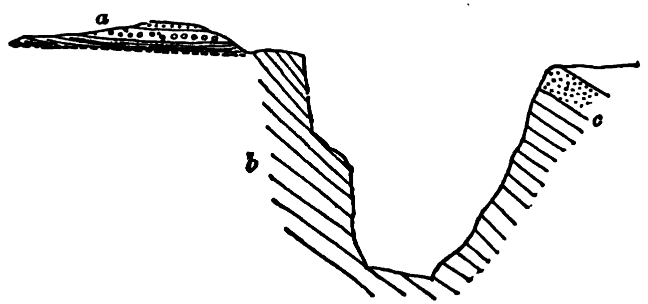

FIG. 2.—Section showing relations of slate and conglomerate in the grounds opposite Glyn Padarn, Llanberis.

a. Conglomerates, etc. *b*. Purple slates. *c*. Grit.

There are also at several places patches of purple slate between the felsite and the conglomerate, and at the summit of Cefn Du the purple slates are seen dipping *towards* the felsite, while the conglomerate and grit are found on the surface above the slates.

It is next shown that the bands called slate by Prof. Bonney, and compared by him to the matrix of chiastolite slate, are really igneous rocks of intermediate composition running in tongues into the felsite on what would be their upper side if they had been sedimentary. From the resemblance of these dykes to bands in the Moel Tryfaen adit section, it is suggested that though they are not micaceous now, but chloritic, they may have been originally lamprophyres.

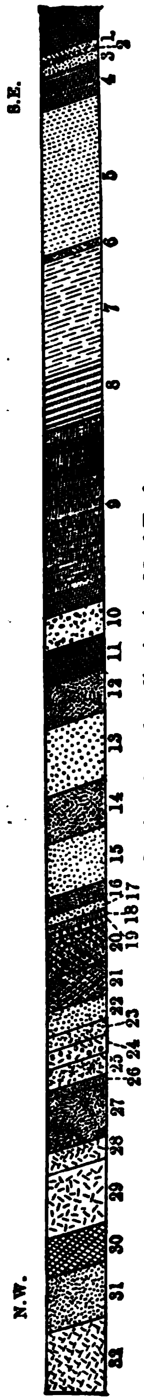

Fig. 3.—Section along the adit piercing Moel Tryfaen.

Conglomerates, as stated by Mr. Marr, have now been found between the felsites and the purple slate in the Bettws Garmon Valley, but it is suggested that, if they are the same as the others, as they look to be, they may have been let down along the continuation of a fault which is clearly shown to exist along the same line further south.

A detached section is next given of the adit under Moel Tryfaen [fig. 3]. Here, commencing at the eastern end, is seen a 3 ft. 6 in. band of conglomerate standing next to the purple slates, and followed below by well-characterized banded slates, so that it occupies the position of the Rhiw-wen grit. Below follows the whole of the recognized succession down to the laminated grits, including the characteristic Bangor breccia. Felsites occur at four distinct horizons, in each case followed by a felsitic grit. It is thus proved that felsite is not to be found only at the base of the Cambrian, and that the only conglomerate is at the top of the sequence and not connected with any felsite. The great conglomerate on the surface is considered to be distinct from that in the adit, as it has a horizontal extension of 165 ft., and shows nearly horizontal bedding in places. Similar material also covers, on the north side of the hill, all the series between the lowest felsite and the purple slate. It is thus considered to be proved to be an unconformable deposit.

Similar conglomerates and associated characteristic grits lie on a different portion of the series on Mynydd-y-Cilgwyn, so that these cannot be the same as the thin conglomeratic band in the Moel Tryfaen adit. The similarity of all the grits, etc., thus considered unconformable to the not far distant Bronllwyd grit and its associates, leads to the belief that they are an overlap of the latter on the "Cambrian." As there is thus an unconformity in the midst of the series hitherto all called Cambrian, it becomes a question for which of the two parts that name ought to be retained.

*114. Hicks, H.—On the Base of the Cambrian in Wales.

Geol. Mag., Dec. 3, vol x. pp. 548–550. (Read at B. A.)

The author recounts the localities where he has met with conglomerates believed to be at the base of the Cambrian. These have all been previously described by him, except, perhaps, "those which were discovered by Prof. Hughes and the author on the east side of the Transfynydd Road, between Cae-Cochion and Penmaen."

***115. Blake, J. F.—On the still possible Cambrian Age of the Torridon Sandstones.**

Rep. Brit. Assoc. for 1892, p. 713.

The author protests against the assumption that there can be no Cambrian rocks below those containing *Olenellus*. He points out the greater lithological similarity of the Torridon Sandstone to known Cambrian than to any known pre-Cambrian rocks, and argues that the Durness fauna has been recognized by C. D. Walcott as Ordovician, and that the species of *Olenellus* discovered in the fucoid beds does not belong to the same section of the genus as that which is known to occur below *Paradoxides*, and the genus as a whole may have a greater range than has been supposed.

116. Roberts, T.—Notes on the Geology of the district West of Carmarthen.

Quart. Journ. Geol. Soc., vol. xlix. pp. 166–170.

In this paper is recorded the existence north of Whitland of a dome which passes into an east and west anticlinal. This is indicated by the occurrence within a circumscribed area of shales with fossils of Arenig age, viz.:—

Dictyonema, sp.	Tetragraptus Headi.
Dendrograptus, sp.	——— serra.
Didymograptus nitidus.	Callograptus Salteri.
——— patulus.	——— persculptus.

The *Didymograptus Murchisoni* beds occur round this dome and also to the east of it.

The Llandeilo limestone is seen along the southern side of the anticlinal, and has yielded—

Asaphus tyrannus.	Beyrichia complanata.
Homalonotus.	Orthis testudinaria.
Calymene cambrensis.	Strophomena llandeiloensis.

but it cannot be recognized on the north side.

Above these on the south side are found the *Dicranograptus* shales at St. Clear, the graptolites from which locality have long ago been named by Prof. Lapworth, and the same shales can be traced along the north side.

Nothing higher is seen on this side, but at Llandowror, near St. Clear, are some Upper Bala limestones with—

Calymene senaria.	Cybele verrucosa.
Cheirurus juvenis.	Illænus Bowmanni.
——— bimucronatus.	Orthis calligramma.

***117. Lake, P., and Groom, T. T.—The Llandovery and Associated Rocks of the Neighbourhood of Corwen.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 426–439.

This is a description of a small area about 1½ miles from east to west and half a mile from north to south, on the

northern slopes of the Berwyns. It is affected by an east and west fault, cut by others having a south-easterly direction. The principal bed traced is the Corwen grit, which differs from the Denbigh grits in not being felspathic but almost as pure as a quartzite. This is thrown into a number of broken synclines with steep northern limbs, and in one of the transverse valleys, Naut Caurddu, which runs along a fault, its disposition is very curious. The two cheeks of the fault run for some distance nearly parallel, with scarcely any throw between them, and then one side is bent up into a sharp curve and the other let down in a rapid slope [fig. 4].

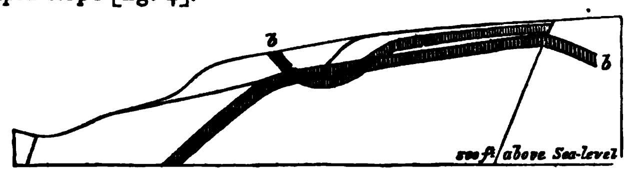

FIG. 4.—Section showing the two sides of a fault in Llandovery rocks.

The series of rocks in this district is :—

Llandovery	Pale slates. Graptolite shales. Grey slates with bands of grit. Corwen grit.
Bala	Blue slates.

The blue slates below the Corwen grit contain a Middle Bala fauna, the list of which is given as coming from (1) beds immediately below, (2) beds not far below, (3) lower beds.

Leptæna sericea, 1, 2, 3.	Conularia Sowerbyi, 1, 2, 3.
Orthis elegantula, 1, 2, 3.	Holopæa striatella, 2.
—— testudinaria, 1, 2, 3.	Illænus Bowmanni, 1, 3.
—— calligramma, 1, 2.	Trinucleus seticornis, 3.
—— biforata, 1.	Calymene senaria, 3.
—— porcata, 1, 2, 3.	Phyllopora Hisingeri, 1, 2.
Strophomena rhomboidalis, 1, 2.	Ptilodictya dichotoma, 2.
—— simulans, 1.	—— explanata, 2.
Lingula ovata, 1.	Pinnatipora Sedgwicki, 1, 2, 3.
Orthoceras ibex, 1.	Favosites fibrosa, 1, 2, 3.

In the Corwen grits at Corwen the authors have not succeeded in finding any fossils, but they quote *Favosites alveolaris* found by Prof. Hughes, and other fossils from elsewhere.

In the grey slates are found :—

Leptæna sericea.	Calymene Blumenbachii.
Orthis elegantula.	

The graptolitic shales are black and sometimes very crowded with fossils, referred to :—

Monograptus tenuis.	Monograptus fimbriatus.
—— gregarius.	Diplograptus sinuatus.
—— leptotheca.	—— tamariscus.
—— convolutus.	Petalograptus ovatus.
—— Nicoli.	Climacograptus normalis.

which indicate the "*convolutus*" division of the "*gregarius*" zone of the Lower Birkhill.

No fossils are recorded from the pale slates.

From these observations the authors conclude that the Upper Bala is here wanting, though there is no sign of unconformity below the Corwen grit. Two lists of fossils from Glyn Ceiriog, about eight miles away, are given for comparison.

*118. Fox, Howard, and Teall, J. J. H.—On a Radiolarian Chert from Mullion Island.

Quart. Journ. Geol Soc., vol. xlix. pp. 211–215.

The main mass of the island of Mullion is a greenstone resembling a lava of the Pahoehoe type. The stratified rocks, which only form a very small portion on the south and west sides, consist of cherts, shales, and limestones, which cannot be traced continuously, and are overlain and underlain by the greenstone. The chert occurs in the shale in bands, which are from a quarter to several inches thick. Their colour is black to grey, and they are often traversed by a network of white quartz veins; the Radiolaria are exposed on the weathered surfaces. The limestone is not directly connected with the shales. The want of alteration in the shales and the ropy structure of the greenstone, indicate that the latter is probably a submarine lava which has insinuated itself between the layers of a contemporaneous deposit. It is thought probable that Mullion Island lies to the north of the fault which separates the slates on the mainland from the Lizard schists, and hence that the Radiolarian cherts belong to the former series.

*119. Fox, Howard.—The Radiolarian Cherts of Cornwall.

Geol. Mag., Dec. 3, vol. x. p. 558. (Read at B. A.)

These cherts have now been found at Pendoner, Beach, Veryan, Portloe Point, and Pencunnan Cove, as well as at the south end of Nelly's Cove, Porthallow, Meneage, to near Ligarath Point, south of Nore Point. The same beds may also be traced, less satisfactorily, inland for several miles. Some show no traces of Radiolaria, but most of them indicate their presence in some way. The Meneage and Veryan cherts are associated with the well-known Ordovician quartzites of these districts, and appear to lie immediately beneath them.

120. Peach, B. N.—On a widespread Radiolarian Chert of Arenig Age from the Southern Uplands of Scotland.

Rep. Brit. Assoc. for 1892, pp. 711, 712.

This is a description of the strata from whence came the Radiolaria described by Dr. G. J. Hinde in No. 78, 1890. The

chert zone lies beneath the Moffat shale group; it is divisible into an upper sub-zone of dark lydian-stones and massive grey chert, a middle sub-zone of green chert, and a lower sub-zone of red and chocolate coloured chert and jasper. The chert beds or nodules are separated from each other by the finest sediment, and towards the base by tuff and agglomerate, the latter containing angular fragments of Radiolarian chert. The whole rests on a platform of basic lavas and agglomerates. The chert is seen on the crest of the anticlinals over an area of 2000–3000 square miles in the northern half of the uplands. The author regards the deposit as a true Radiolarian ooze, becoming more sedimentary towards the north, where the land must consequently have lain.

121. Forsyth, D.—The Geology of the Carsphairn District.

Trans. Geol. Soc. Glasgow, vol. ix. pp. 376–389, plates xiv., xv.

The rocks in this district are much contorted, but in all the contortions a set of grits and graptolitic shales cling to each other. There are several masses of granite, which produce intermittent contact-metamorphism. Sections are given at five different localities where graptolites are met with. These belong in part to the Glenkiln and in part to the Hartfell series, one side of a shale bed containing the forms of one series and the other of the other series. These two thus seem to come together without any intervening grits. The graptolites recorded from these sections are:—

Lasiograptus costatus.
——— bimucronatus.
Climacograptus bicornis.
Cænograptus gracilis.
——— tricornis.
Leptograptus grandis.
——— simplex.
Glossograptus Hincksii.
Dicranograptus ramosus.
——— tardiusculus.
Dicranograptus Nicholsoni.
Dicellograptus sextans.
Didymograptus superstes.
Diplograptus euglyphus.
——— quadrimucronatus.
——— foliaceus.
——— apiculatus.
——— Whitfieldii.
Pleurograptus linearis.

The arrangement of the strata appears at first sight to be synclinal with the flags at the base, then the graptolitic shales and then the grits; but a consideration of the distribution of the species of graptolites shows that this order must be reversed, the grits forming the centre of an anticlinal, wrapped round by the shales, and followed by the flags. Some muddy shales between the last two correspond to the Ardwell beds, and the banded cherty flags which accompany the shales may represent the Stinchar limestone.

121a. Anon.—Lists of Fossils.

Caradoc Record of Bare Facts, 1892, pp. 23, 24.

This consists of the record of discovery of certain well-known fossils in the following localities:—

1. In a well at Bishop's Castle, probably in Aymestry limestone, 3.
2. Norton, Downton sandstone, 1, 2.
3. North Lydbury, Upper Ludlow, 2; and in Aymestry limestone, 1.
4. Caradoc coppice, Aymestry limestone, 6.
5. All Stretton, Lower Ludlow, 4.
6. All Stretton, Sandy Upper Ludlow, 5.

DEVONIAN.

***122. Hunt, A. R.—An Examination of some of the Evidence advanced by the Rev. Professor T. G. Bonney, D.Sc., in support of the Archæan Age of the Devonshire Schists.**

Hertford, 8vo, pp. 17. (Privately printed.)

In this paper the author makes no attempt to elucidate the question of the Devonshire schists beyond the point reached in No. **92**, 1892, but endeavours to show that the opposite view rests upon inaccurate observations.

***123. Hicks, H.—Some examples of Folds and Faults in the Devonian Rocks at and near Ilfracombe, North Devon.**

Geol. Mag., Dec. 3, vol. x. pp. 3–9.

According to the author, the present interpretation of the succession in North Devon is erroneous. "Instead of being one continuous series, with a regular dip to the south, the beds are much folded in several broken troughs." He gives the following illustrations of this statement:—

1. Combe Martin Bay.—Here on the north-west there are folded grits and flaggy sandstone, the average fall towards the south-east being very small. Then comes a fault, on the other side of which are calcareous beds bent into a low irregular arch. Similar folds, though here inverted, are seen in the flaggy sandstones in the north-east face of Sandy Bay, the cleavage in both cases being inclined at a very high angle to the south-east. The order of succession is such as would accompany a gradual depression, with a shore line not far off Hangman's Point. Going south from Combe Martin, the flaggy beds rise higher and higher in the hills till they abut against Morte slates. About a mile west of Combe Martin the calcareous beds are thrown into corrugated folds, whose axis is nearly horizontal. At the Watermouth Caves and on the shores of Watermouth Bay, the arches are broken and form lines of weakness, which have determined the positions of the indentations on the coast.

2. Hele Bay and Hillsborough.—The beds here are intensely folded, though the strong cleavage planes produce a very

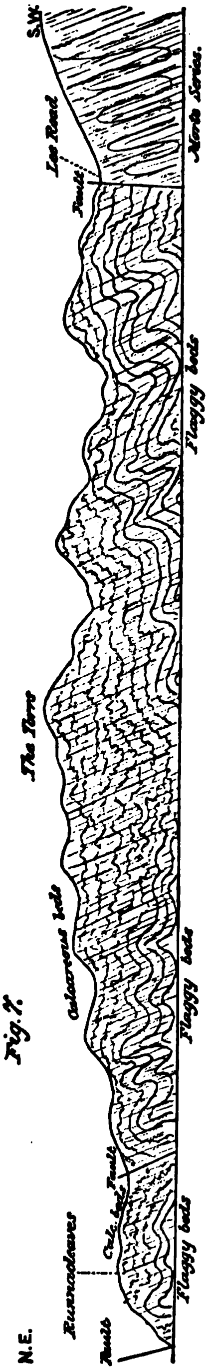

FIG. 5.—Section showing the folding and cleavage of the Devonian Rocks at Ilfracombe.

deceptive appearance. On the west side the beds are thrown bodily forward by a fault. If a section be run southward from Hillsborough the folds become wider, till they abut on the fault which brings in the Morte slates.

3. Ilfracombe itself shows an S-like fold, the synclinal part of which forms the summit of Lantern Hill, while the Capstone Hill is a low anticlinal. A long section [fig. 5], running from N.E. to S.W. through the Torrs, shows corrugated folds with very little total dip till the fault is reached, beyond which the Morte slates are compressed into nearly vertical folds. It is only the cleavage which has a constant dip towards the S.E. The beds at the point outside the ladies' bathing-place are freely covered with ancient worm tracks, and they are overlain by calcareous beds which rise into the central group of the Torrs, while the Torrs to the south are made of flaggy beds, and have more even slopes.

The result of all this is that the thickness of the rocks in this neighbourhood is much less than has been supposed. The Morte slates themselves are found to contain a fairly rich fauna of Silurian type.

124. Painter. W. H. — The Devonian Rocks of Ilfracombe and Barnstaple.

Midland Naturalist, vol. xvi. pp. 84-89 and 102-107.

The beds between Combe Martin and Ilfracombe dip 83° to E.S.E. Various other notes are given of already known facts. The author ascribes the terminal curvature of the slates by the side of the river Taw to "earth-creeping," *i.e.* "the gradual movement of the surface of the earth upon a slope, a phenomenon which may be seen on the side of a hill." This is stated to have been suggested to him by Prof. Lapworth. The raised beach at Westward Ho is also noted and figured.

CARBONIFEROUS.

***125. Ricketts, C.—On some Conditions existing during the Formation of the Older Carboniferous Rocks.**

Proc. Liverpool Geol. Soc., vol. vii. pp. 94–106.

Some of the beds which have been called Old Red Sandstone in the north and west of England, near Llangollen and Kirby Lonsdale, are merely basal beds of the Carboniferous. At Horton, in Ribblesdale, and in Wastdale these deposits seem to be limited to the same valleys as those in which the present streams are running. They are local deposits of the débris of the underlying rocks. In the dales around Ingleborough the lower beds of limestone are full of pebbles of the rocks below, but at Beecroft Quarry, near Horton, the lowest limestone above the basal conglomerate is black, and above it is 3 in. of coal. The thickness of the lower deposits shows great variation, and the impurities of the limestone are also local in origin, but the material of the limestone itself has been brought in solution from a distance. That the limestone was formed in shallow water is shown by the occurrence in it of seams of coal on various horizons, as at Hutton and Ingleton Quarry, where, also, there are indications of an eroded land surface. Other examples are quoted near Stony Middleton, between Millersdale and Tideswell, and on the north of Carnforth. In the Upper Carboniferous Limestone coming changes are indicated by the appearance of a quantity of carbonaceous matter and of silica.

***126. Jones, T. R.—Coal: its nature, origin, position, and extent; and its range under the South of England.**

Trans. Hertfordshire Nat. Hist. Soc. and F. C., vol. vii. pp. 89–100, plates i., ii.

A general lecture on the subject. The author considers the Jurassic rocks of the Dover boring to include the Lias [*cf.* Introductory Review, 1892].

***127. Jones, T. R.—The Origin and Distribution of Coal.**

Ann. Rep. Brighton and Sussex Nat. Hist. Soc. for 1892, pp. 22–25.

An abstract of a lecture.

128. Stocks, H. B.—On certain Concretions from the Lower Coal-Measures, and the fossil plants which they contain.

Proc. Roy. Soc. Edinburgh, vol. xx. pp. 69–75.

The concretions referred to are found at Halifax in Yorkshire, and at Oldham in Lancashire, where they are called "coal-balls." They occur in the "hard-bed" of the Gannister series, which is

overlain by shales with marine fossils and underlain by underclay. The coal-balls vary from 3 in. to 1 ft. in diameter; they have a grey, brown, or pyritous interior, and are, in fact, the source of the beautifully preserved coal-plants studied by Prof. Williamson. Two analyses are quoted from the author's paper to the Yorkshire Geol. and Polyt. Soc. in 1883, which show that the bulk is carbonate of lime and iron pyrites. Analyses are now given of the fossil wood itself:—

Carbonate of iron	5·77	1·12	3·57
Ferric oxide	1·60	0·59	2·77
Carbonate of lime	23·88	87·01	49·05
Carbonate of magnesia	1·49	3·19	6·21
Calcium sulphate	14·40	1·29	9·28
Silica	0·30	0·01	0·80
Iron pyrites	48·63	4·75	24·25
Organic matter	4·03	3·43	4·79
	100·10	101·39	100·72

The author thinks that these plants have grown *in situ*, in the neighbourhood of the sea, and that the sulphate of lime from the sea-water has oozed through and reacted on the carbon of the decaying plants, producing calcium sulphide and carbonic acid, which again react with iron and produce pyrites. Thus the process of alteration commences immediately, and the plants have no time to decay.

***129. Stirrup, M.—Further notes on Boulders from the Coal-Measures.**

Trans. Manchester Geol. Soc., vol. xxii. pp. 321–330.

Records a number of new examples of these boulders. 1. From the "Roger Mine" coal worked at 560 yards below the surface at Ashley Pit, Dukinfield. The largest, weighing 14 lbs., is a flattish rounded boulder of grey quartzite, occurring in the top of the seam. A second weighs 7 lbs., and is like the first; while a third is of grey grit. 2. From the Middle coals at Crumbronke Mine, Wigan, an oval stone weighing 1½ lbs. composed of felstone or "quartz-porphyry." 3. From the Lower coals at Bacup. In the roof of the Gannister Mine, Fox Hill, an oval stone weighing 1 lb., probably a crushed and decomposed dolerite; a second, weighing ¾ lb., of biotite granite; and a third, weighing 1½ lbs., of banded biotite gneiss. None of these rocks are sufficiently characteristic to suggest any special point of origin, nor will the author venture to say how they have been brought to their present positions.

130. Hannah, D.—Roofs of some of the principal Seams of Coal in the Rhondda Valleys, and how to treat them.

Proc. South Wales Inst. Eng., vol. xviii. pp. 177–199, plate xii.

The roofs in this district, as compared with those in other districts, are dangerous and bad. In the Steam-coal series there is an absence of the coarse-grained sandstones which form such an excellent roof in the Upper or House-coal series. The particular roofs described are those of the "two-feet nine," the "four-feet," and the "six-feet" seams.

Immediately above the two-feet nine seam comes 2 ft. of bastard fireclay with clift and fossilized rootlets. This bed, owing to its clayey nature and the weighting of the strata when the coal is removed, forms "slants," which, running into each other and terminating in an apex upwards, form conical shaped pieces, locally known as "bells," making this roof to be of a dangerous character. Next come 10 in. of carbonaceous shale, then a 16 in. coal-rider, followed by six beds of clay, "quarr," and "clift" for 6 ft. 11 in., overlain by a strong quarr, which makes the best roof.

Above the four-feet coal, which is really 5 ft. 6 in. in thickness, comes a number of layers of clift, interbanded with layers of ironstone nodules. The clifts are slaty in appearance, and make a very bad roof.

The beds overlying the six-feet seam are composed of clift, beds of nodular ironstone, and quarr.

Faults, rolls, undulations, and overlaps are also noticed, but the bulk of the paper is occupied by recommendations as to working, which are illustrated by the plate.

131. Kidston, R.—On the Fossil Plants of the Kilmarnock, Galston, and Kilwinning Coal-fields, Ayrshire.

Trans. Roy. Soc. Edinburgh, vol. xxxvii. pp. 307–310, etc.

The introductory portion of this memoir gives details of the structure of the coal-fields. Its length is about 19 miles, and its greatest breadth in the centre 12 miles. All the coals belong to the "Lower Coal-measures," but these consist of two groups. The upper series consists of red and purple sandstones and clays, and is barren of coals. The lower series consists of grey, white, and yellow sandstones, fireclays, coal-seams, and ironstones. Sections of the strata are given at (A) No. 1 Pit, Grange, Kilmarnock; (B) No. 1 Pit, Windy Edge, 2½ miles W.N.W. of Kilmarnock; (C) No. 6 Pit, Bonnington Colliery, 1 mile W.N.W. of Kilmarnock; and (D) at Annandale Colliery, 2 miles W. of Kilmarnock. E is a general section of the Kilwinning Coal-field. Curious balls of coal occur in some of the seams, which do not differ in composition from the rest of the seam, the bedding of which passes through them.

A.	ft.	in.	B.	ft.	in.	C.	ft.	in.	D.	ft.	in.	E.	ft.	in.
Upper Series	420	0	Upper Series	160	0									
Strata	21	4	Strata	79	6									
Stranger Coal	1	10	Stranger Coal	1	0									
Strata	60	0	Strata	15	2	Strata	124	0	Strata	136	8			
McNaught Coal	2	10	McNaught Coal	3	3	McNaught Coal	3	0	McNaught Coal	3	0			
Strata	36	0	Strata	33	8	Strata	31	0	Strata	13	0			
Tourha' Coal	3	0	Tourha' Coal	3	4	Tourha' Coal	3	0	Tourha' Coal	3	0			
Strata	84	0	Strata	59	9	Strata	55	0	Strata	88	0	Strata	80	0
Major Coal	4	0	Major Coal	3	0	Major Coal	4	0	Major Coal	4	0	Major Coal	6	0
Strata	78	0	Strata	70	0	Strata	80	0	Strata	85	0	Strata	80	0
Stone Coal	2	9				Durroch Coal	2	8				Five Quarter Coal	4	0
Clay	5	1	Main Coal	5	0	Strata	19	6	Main Coal	5	8	Strata	61	0
Stone Coal	2	3				Whistler Coal	2	3				Parrot Coal	3	0
Strata	72	0	Strata	69	6	Strata	58	3	Strata	59	10	Strata	18	0
Splint Coal	3	0	Splint Coal	3	0	Splint Coal	2	3	Splint Coal	3	2			
Clay	1	0	Fireclay	1	0	Clay	1	3						
			Turf Coal	1	8	Turf Coal	1	6						
Turf Coal in two parts	4	0	Fireclay	1	0	Stone	0	4	Turf Coal in two parts	3	4			
			Turf Coal	1	6	Turf Coal	1	6				Turf Coal	3	0
Strata	3	0	Strata	2	8	Strata	2	6	Pavement	4	0	Strata	20	0
Wee Coal	2	6	Wee Coal	1	0	Wee Coal	2	10	Wee Coal	1	9	Wee Coal	2	0
			Strata	0	9	Strata	71	0	Strata	5	0	Strata	146	0
						Ell Coal	1	0				Lady Ha' Coal	2	0
						Strata	107	6				Strata	48	0
						Coal	1	8				Ell Coal	3	0
						Strata	8	3				Strata	52	0
												Stone Coal	3	0
												Strata	10	0
												Smith's Coal	2	0
												Strata	19	0
												Main Coal	4	0
												Strata	29	0
												Raes Road Coal	2	0
												Strata	120	0

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132. Moore, R. T. — Recent Developments of the Hamilton Coal-field.

Proc. Phil. Soc. Glasgow, vol. xxiv. pp. 51–63, plates ii., iii.

Only the Coal-measure coals are worked in the Hamilton district, and of these only the upper part, down to the Splint and Virgin coal. Where the seams are fully developed they contain 30 ft. of coal in seams over 2 ft., but the average total is not more than 22 ft. The area over which the Splint coal is found is 80 square miles, but the higher Ell coal only extends over 66 square miles. This area, of which a map is given, lies to the east of Glasgow. A section through it shows the faults and consequent changes of position of the Splint coal between Govan and Netherburn.

The general section of these upper coals is:—

	ft.	in.		ft.	in.
Upper Red Sandstone				456	0
UPPER COAL	2	0	to	4	6
Measures				90	0
ELL COAL	4	10	to	7	0
Measures				48	0
PYOTSHAW COAL				4	7
Measures				24	0
MAIN COAL	3	1	to	4	7
Measures				47	0
HUMPH COAL				3	0
Measures				42	0
SPLINT AND VIRGIN COAL	4	6	to	7	0

It is calculated that up to the present time 668 million tons of coal have been extracted, and that 265 million more tons are left, so that, at the present rate of output of 11 million tons a year, the field will be exhausted in 24 years.

***133. Bennie, J. — Scenes and Sections in Thornton Quarries, East Kilbride, in 1868.**

Trans. Geol. Soc. Glasgow, vol. ix. pp. 276–285.

An account of the author's visits to these quarries at various times, from 1868 onwards. He gives a section in quarry No. 1 of 26 beds, of total thickness 53 ft., and notes that special kinds of fossils are characteristic of certain beds: thus, one bed is full of coprolites, a second of fish scales, a third has innumerable fish palates, and a fourth is full of entomostraca.

134. Maclaren, R.—A Reverse Fault in Kiltongue Coal at Drumshangie Colliery.

Trans. Geol. Soc. Glasgow, vol. ix. pp. 390, 391.

The Kiltongue coal is in the "Upper Coal-measures" [*see* No. **131**], about 180 ft. below the Airdrie blackband ironstone.

The fault makes an angle of 30° with the horizon. The beds on one side dip at an angle of 5° and on the other of 14°, both in the same direction, and the throw is about 2 ft. The coal is in two bands, and by means of the fault the lower band is brought to be partly continuous with the upper.

135. Maclaren, R.—A Reverse Fault in Kiltongue Coal at Drumshangie Colliery.

Trans. Min. Inst. Scotland, vol. xiii. pp. 285, 286, plate lxix. (1892).

Gives details proving the fault.

***136. Gresley, W. H.—Geological History of the Rawdon and Boothorpe Faults in the Leicestershire Coal-field.**

Trans. Fed. Inst. Mining Eng., vol. iv. pp. 431–436, plate xx.

The Rawdon fault is remarkable for the breadth of the fault material, which amounts to 38 ft. and includes a large mass of coal. The Boothorpe fault has a throw of 1000 ft., and a breadth of 12 ft. of fault material. It is concluded that the Rawdon fault is the older of the two, and has been converted by later movements from an upthrow on the east to a downthrow, and that at one time it formed an open gap into which the débris has fallen.

***137. Bertrand, M.—Sur le raccordement des basins Houilliers du Nord de la France et du Sud de l'Angleterre.** [On the correspondence of the Coal Basins of the North of France and of the South of England.]

Annales des Mines, vol. iii. pp. 1–83, plates i., ii.

The author considers it to be well established by numerous observations, which he cites, that the law he previously enunciated [No. **54**, 1892], and which was stated in a general way by Godwin-Austen, holds good exactly, viz. that the folds of later periods follow the lines of more ancient folds, and by this means he traces the exact continuation of the axis of Artois into the Boulonnais. It does not run to the north of this area, as supposed by Godwin-Austen, nor yet to the south of it, but splits up into two axes which enter the Boulonnais itself. The axis belonging to the north of the Boulonnais corresponds to that which limits the Weald to the north and reaches the sea at Wissant. There is a minor fold between Folkestone and Dover, which trends at a little distance from the shore in an easterly direction, and so is carried to the east side of Calais. From this correlation the conclusion is reached that if the coal basin of Dover is to be found in France, it will be between Calais and Dunkerque, while the Calais basin itself is a distinct one.

PERMIAN AND TRIAS.

138. Dickson, E.—Note on a Section at Skellaw Clough, near Parbold.

Proc. Liverpool Geol. Soc., vol. vii. pp. 106–108.

This section has been twice described, but no fossils have hitherto been found to prove that the rocks are Permian. The author has now found in the red marls below the limestones the cast of a *Schizodus* and other fossils, of which he promises a fuller description. The magnesian limestone here contains 24·15 per cent. of magnesium carbonate, but neither it nor the basal sandstone have yielded fossils.

139. Farrington, T.—The Magnesian Limestone of the Cork District.

The Irish Naturalist, vol. ii. pp. 135–139.

The bands of magnesian limestone that are worked for magnesia in the neighbourhood of Cork, have been considered to owe their composition to infiltration along the joints of the Carboniferous Limestone on which they lie; but the author gives reasons for believing that they are of Permian age, and have been deposited unconformably in the fissures. These reasons are:—1. The bands have a constant east and west strike. 2. They are always on the surface, wedged in between the masses of the limestone. 3. They diminish downwards in an irregular manner. 4. Both limestone and dolomite are covered by gravelly deposits. 5. The line of demarcation between the two is always sharp, and the composition of the rock on the two sides of this line is very different. 6. The dolomite is generally less pure. 7. At the junction line slaty scales are found. The dolomite is also in the form of saccharoidal marble, while the limestone is not nearly so much metamorphosed. But little light is thrown on the question by the fossils, as only obscure traces of crinoids have been found in the dolomites.

*140. Porter, J.—Magnesian Limestone in the Neighbourhood of Cork.

The Irish Naturalist, vol. ii. pp. 221–223.

The author replies to No. **139** that undoubtedly metamorphosed Carboniferous Limestone occurs in a vertical dyke-like mass near Mallow; that the impurities mentioned are only those which have been introduced by percolating waters; that the forms of the cavities in which the deposits lie could not well be due to ordinary erosion; and that there was not sufficient time before the Permian period commenced for so much erosion to have taken place.

***141. Hewitt, W.—The Physical Conditions of the Aralo-Caspian region as bearing on the conditions under which the Triassic Rocks were formed.**

Proc. Liverpool Geol. Soc., vol. vii. pp. 11–35.

A presidential address, giving numerous interesting details about this region, though little is said as to their bearing on the conditions of the Triassic deposits. It is noted, however, that the red colour cannot be due to subaerial disintegration of the rocks from whence the sand-grains of the Bunter have been derived, because these grains have been rounded first and coated afterwards.

***142. King, W. W.—Clent Hills Breccia.**

The Midland Naturalist, vol. xvi. pp. 25–37.

This breccia at Clent is at least 84 ft. thick and very hard. The fragments range from a grain up to 19×15×12 inches, but only three out of many thousands collected show any striæ, though all are angular or subangular. There are also some signs of stratification. At, Wychbury, Clent, Walton, and Romsley the fragments comprise Cambrian quartzite, like that of the Lickey, Llandovery sandstone, with fossils, a list of 80 of which is given, and beach rock of Cambrian and Uriconian débris. It was doubtful whether any other stratified rocks occur in the breccia, for the specimens quoted of Carboniferous and Permian sandstones had then only been found on the surface of the ground. The large blocks and the fragments of fossiliferous rock are found mostly on the west side of the hill. Fragments of acid igneous rock like those of the Lickey also occur. It is noted that the Abberley Hills breccia contains Downton sandstone, Upper Ludlow limestone and Old Red Sandstone, and on Llandovery sandstone had been found, while the breccia at Enville is similar in its contents to that of Clent.

As to the origin of these breccias, they cannot have been actually derived from the Lickey Hills, as these were not elevated till post-Permian times, and they cannot have been distributed by ice coming from the Longmynds, because so few are scratched or rounded, and they are not mixed in composition, but largely correspond to local rocks. Taking all the data into consideration the author submits that the fragments can only have travelled a short distance from their original site, and must be derived from some boss, peak, or ridge, composed partly of Llandovery sandstone resting unconformably on the Cambrian. The aggregation of the fragments may have taken place in part by the violent succussion of the rocks during the displacements which followed the Carboniferous period, or by the method described by Dr. Blanford in Q.J.G.S., vol. xxix. p. 493.

143. Bonney, T. G.—On the relation of the Bunter Pebbles of the English Midlands to those of the Old Red Sandstone Conglomerates of Scotland.

Rep. Brit. Assoc. for 1892, p. 711.

The author has recently examined the Old Red conglomerates near Stonehaven, Kirriemuir and Callander, and the resemblance of their pebbles to those in the Bunter confirms him in his opinion that the latter have been derived from the North.

144. Goodchild, J. G.—The St. Bees Sandstone and its Associated Rocks.

Rep. Brit. Assoc. for 1892, p. 722.

Published in 1892 in the Geol. Mag. [see No. 105, 1892].

***145. Goodchild, J. G.—Observations on the New Red Series of Cumberland and Westmoreland, with especial reference to Classification.**

Trans. Cumberland and Westmoreland Assoc., No. xvii. pp. 1–24, plates i, ii.

The question discussed is the position above the magnesian limestone of the dividing line between the Permian and Trias, if any such dividing line is drawn.

Beginning the examination of the country at the north, the highest beds which occur near Carlisle are cut off on the south by the great Maryport fault. Beyond this there are beds above the St. Bees sandstone preserved in synclinals at Castle Carrock and Kenwick: these are bright red ochreous and white sandstones, which may be easily recognized as the same as those of Kirklington. From the horizon thus determined the rocks may be traced downwards, almost without a break, for 2000 ft. Some distance below the bright red zones we reach the horizon of the highest beds at St. Bees Head; then the series graduates through flagstones, interbanded soon with slates, to red and gypsiferous marls 300 ft. thick. These latter lie directly on the Penrith sandstone, "the Magnesian Limestone series, which lies in the areas to the west and again to the south-east, being here entirely absent." This is really the typical Trias section of the district, and shows that the series intervening between the magnesian limestone and the Keuper marls is 2300 ft. thick. The author would prefer to call all the sandstones of this series simply the Bunter sandstones and the underlying marls the Bunter marls.

At Kirkby Stephen the Bunter marls rest upon Brockram. At Hartley there is a remnant of the plant beds intervening, and two miles to the north the magnesian limestone also is well

developed. At Newbiggin station Bunter marls lie on the edges of the plant beds: this and the irregular occurrence of the latter indicate that they had been subject to denudation before the deposit of the former. The Bunter marls also show occasional bands of conglomerate; hence, if the series is to be divided at all, the author would draw the line at the base of the Bunter marls, which, indeed, is the only place where any line is possible.

The author then goes into general matters, and argues against classing the St. Bees sandstone as Upper Permian, especially if the latter be called Palæozoic. A general history of the period is then sketched, in which the plant remains discovered by Mr. Brockbank [No. **104**, 1892] are referred to. A table of succession embodying the statements above made concludes the paper. From this table we learn that the "New Red Series" is to be labelled "B." The "Upper New Red," or beds described above, is "B3." The Magnesian Limestone Series, including magnesian limestone 0–10 ft., plant beds 150 ft., is "B2." The "Lower New Red," which is unfossiliferous, is "B1," and is to be subdivided into Copper-Red Sandstone, "1 iv."; Upper Brockram, "1 iii."; Penrith Sandstone, "1 ii."; and Lower Brockram, "1 i." Appended is a geological map of Cumberland and Westmoreland, and a table of sections of the New Red Series in different parts of England.

***146. Aveline, W. T.—The St. Bees Sandstone.**

Geol. Mag., Dec. 3, vol. x. p. 87.

The writer thinks that the St. Bees sandstone is not Bunter, the divisions of which are totally unlike it, but that it is more probably a large development of the marls and sandstones which divide the Upper and Lower Magnesian Limestones of Yorkshire.

147. Gordon, Geo.—The Reptiliferous Sandstones of Elgin (with map).

Trans. Edinburgh Geol. Soc., vol. vi. pp. 241–245, plate x.

The author says that except for the discovery of reptile remains in them no one would ever have imagined the Elgin sandstones to be anything else than Old Red. There is absolutely nothing to separate the beds containing *Telerpeton* from those containing *Holoptychius* except their higher position. The conglomerate which was supposed to mark the base of the upper series in Cuttie's Hillock Quarry is now shown to be of very little extent. It is suggested that the two beds of limestone represented on the Survey map, one as capping the Trias, and the other capping the Old Red, may really be the same bed. The map shows the various areas where the Elgin sandstone is exposed on the surface, the position of the quarries, and their fossil contents.

***148. Irving, A.—The Base of the Keuper Formation in Devon.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 79–83.

Last year [*see* No. **109**, 1892] the author showed that, in the country west of Sidmouth but east of the Otter, the base of the Keuper was indicated by a breccia seen on the left side of the Sid near its mouth. Hence the sandstones underlying the marl series east of the Otter but west of Sidmouth, including the current-bedded sandstones in which reptilian remains have been found, were taken to be Upper Bunter. Since that paper was read, however, a similar breccia has been found at Harpford, on the east side of the Otter, and has been traced thither for a considerable distance along the Otter valley *viâ* Newton Poppleford, Press Lane, Burnt House, Halse's Lane, and North Moston Farm. In some places it is underlain by sandstones with calcareous concretionary masses characteristic of Upper Bunter. From these observations it is concluded that the basal breccia normally runs along the east bank of the Otter and that its occurrence further east at Sidmouth must be due to faulting. This changes the intervening reptiliferous sandstones to Keuper and diminishes the Upper Bunter, which is now considered to be confined to the west side of the Otter and to a thickness of only 100 ft. These changes of correlation bring about an agreement as to the limits of the Keuper and Bunter in Devonshire, between the author and other observers.

149. Richards, P., and Jack, G.—A description of a Section in the Upper Keuper at Shrewley, in Warwickshire, together with a note on the discovery of Cestraciont Fish Remains therein.

Midland Naturalist, vol. xvi. pp. 63, 64.

Above the red marl come about 9 ft. 6 in. of green sandy marls with *Estheria*, having pea-like pebbles at the base. Next come 9 ft. of close-grained sandstone interbedded with green marl, with fish remains at the base; then come 3 ft. of green ripple-marked marl, and finally a thin bed of coarse friable sandstone with small white particles and fish remains. The total thickness seen is 32 ft. It was in the lower of these beds that there were found many palatal teeth of *Lophodus Keuperianus*, four Cestraciont spines, and a piece of Labyrinthodont bone.

***150. Brodie, P. B.—On some additional Remains of Cestracionts and other Fishes in the Green Gritty Marls immediately overlying the Red Marls of the Upper Keuper in Warwickshire.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 171, 172.

Below the principal sandstone in Shrewley Quarry, called the bottom rock, come green sandy marls and then red marls. The former are 8–10 ft. thick, and about 10 in. from the base comes a 3 in. band with many ichthyodorulites, ganoid fish-scales, palatal teeth of *Acrodus Keuperianus*, and other irrecognizable vertebrate remains.

***151. Harrison, W. J.—On the discovery of Molluscan Remains in the Warwickshire Trias.**

Midland Naturalist, vol. xvi. pp. 227–229.

Draws attention to the discovery by Mr. Richards of casts of *Myophoria* and *Schizodus* in the Lower Keuper marls of Shrewley [*see* No. **149**].

LIAS AND RHÆTIC.

***152. Woodward, H. B.—The Jurassic Rocks of Britain, vol. ii. The Lias of England and Wales (Yorkshire excepted).**

Mem. Geol. Survey, London, Eyre and Spottiswoode, 8vo, pp. xii. and 399, with 89 illustrations and a map. Price 7*s.* 6*d.*

This is an extremely important work, containing a large amount of new matter.

Chapter I. gives the author's exposition of his views on "Zones." For him they are not the beds containing one particular fossil, but beds containing "assemblages of fossils which occur in a more or less definite sequence."

Chapter II. The Lias—general account of the strata.—The name may possibly be derived, not from layers, but from the Norman "Liais." A good figure is given showing the lateral variations in thickness of the different subdivisions as traced from Dorsetshire to Yorkshire. It is thought that the limestones of the series, which for the most part are of sedimentary origin, indicate shallower water than the clays. They are of a granular structure, with a crystalline matrix, while the clays are comparable to the "blue terrigenous muds" of the "Challenger" Reports. The author groups together some of the usually recognized zones so as to admit the following 11 only, in ascending order:—

1 Planorbis	5 Capricornus	9 Serpentinus
2 Bucklandi	6 Margaritatus	10 Communis
3 Oxynotus	7 Spinatus	11 Jurensis
4 Jamesoni	8 Annulatus	

A general description of the Lower Lias follows, with lists of characteristic fossils, of which a few are illustrated by the usual diagrammatic figures.

Chapter III. Lower Lias—local details.—In Dorsetshire a long continuous section is given from Bridport to Lyme Regis. The description of this part is mostly new. The Lower Lias admits of four main subdivisions: 1. Blue Lias. 2. Black Marl. 3. Belemnite beds. 4. Green ammonite beds. 1. The Blue Lias comprises the zones of *A. planorbis* and *A. Bucklandi* up to the bed known as the Table Ledge, to distinguish it from the Broad Ledge. A detailed section of this part, with notes on the fossils, is given, showing 32 beds in a thickness of 107 ft. 8 in. In one place *A. Bucklandi* and *A. angulatus* occur together in the same bed. 2. The Black Marl gives its name to Black Ven, where it is best seen. It is the *oxynotus* zone, and is illustrated by a section showing 19 beds in a thickness of 200 ft. 3. The Belemnite beds constitute the zone of *A. Jamesoni*, and the section shows seven beds in 80 ft. In the upper part lies the "Belemnite stone," containing 13 different species of Belemnites, which are the only abundant fossils. 4. The "green ammonite" beds take their name from *A. latæcosta*, which is the local representative of *A. capricornus*. The detailed section includes five beds in a thickness of 105 ft. (excluding the "three tiers"). The Lower Lias saurians have been mostly obtained from the lowest of its subdivisions.

These subdivisions are next traced, as far as possible, inland, and it is noted that in this district what is called "White Lias" is really a white bed in the Lower Lias, the White Lias of other localities, which occupies a lower level, being here called "White rock." A boring at Hambridge Mills gave a thickness of 309 ft. A section of *planorbis* beds at Keinton Mandeville shows 21 beds in 13 ft. 8 in. Dr. Wright's section at Street, compared with the present one, shows considerable variation. The ammonite marble of Marston Magna belongs to the *obtusus* zone, and most of the known specimens are derived from a single large block obtained from a well sunk in 1815. At Sutton, near Alhampton, *A. Simpsoni* occurs. In West Somerset the Blue Lias is well seen in the cliffs between Sturt Point and Blue Anchor, and is illustrated by a horizontal section. There are numerous faults, so that the New Red Marl, the Grey Marls, Black Shales, White Lias, and Lower Lias are repeated again and again. The Lias beds are 150 ft. thick and belong to four zones. There is no conglomerate at the base here.

Chapter IV. Lower Lias (continued)—local details.—Glamorganshire and Monmouthshire. In this district the author settles the dispute as to the relations of the Sutton and Southerndown beds, giving a section along the coast from Pant-y-Slade to Dunraven, whereby it is shown how the white Sutton stone and conglomerate form the base of the series, both at Sutton and Dunraven, and pass up insensibly into the blue and grey conglomeratic Southerndown beds, which are overlain by the ordinary beds of the Lias. The total thickness of the con-

glomeratic series is from 50 ft. to 80 ft., and of the Sutton series 25 ft. to 40 ft. The Sutton stone, when massive, is of a tufaceous character; conglomerates occur as abundantly in the "Sutton series" as in the "Southerndown series"; hard bluish-grey limestones appear in each, and while at Pant-y-Slade there are 70–80 ft. of Southerndown to 30–40 ft. of Sutton, at Witches Point there are only 14 ft. of Southerndown to 40 ft. of Sutton. No divisional line can be drawn between the two; and they form one palæontological group.

Chapter V. Lower Lias—Harptree and Chewton Mendip. —The cherty Lias here is composed of chalcedonic silica, with very few signs of sponge spicules. The development of chert is very local, and when it occurs the underlying Trias is cherty also, so the author concludes that it is an alteration product due to the proximity of some hidden igneous mass. It belongs to the *planorbis* zone. The basal limestones in the Radstock and Paulton area yield the fossils of the several zones of the Lower Lias, so it is presumed that the overlying 100–120 ft. of blue clays, which appear to be unfossiliferous, may belong to the Middle and Upper Lias. At Fretherne *A. Conybeari* and *A. Johnstoni* occur together. The insect limestones from Tewkesbury to Pershore are shown to be on more than one horizon.

Chapter VI. Lower Lias—Evesham to Charlbury.—The "guinea-bed" at Burton is considered to be the base of the Lower Lias. The details of an important boring made at Mickleton in 1890–2 are thus recorded [abbreviated here]:—

		ft.	in.
Middle Lias 280 ft.	Marlstone, etc.	45	0
	Hard bluish-green rock	13	0
	Sands and clays (5 beds)	43	0
	Hard blue marly clay, with *Am. fimbriatus* and *Cardium truncatum* in nodules	179	0
Lower Lias 961 ft.	Hard blue marly clay, with nodules *Am. capricornus*, *Pleuromya costata*	249	0
	Hard blue clay, with bands and shells—*Gryphæa arcuata*, *Inoceramus ventricosus*	299	0
	Limestone	3	6
	Hard black shaly clay	5	6
	Hard clay with shells—*A. semicostatus* (at 60 ft.)	63	0
	Limestone and clays—*A. semicostatus* (3 beds)	92	0
	Limestones, marls, and dark shales—Encrinites	92	0
	Limestone with *A. angulatus*, *A. Charmassei*, *Rhynchonella calcicosta*	8	0
	Limestones and marls	57	0
	Blue shaly limestone—*Cardinia*, *Lima*	6	0
	More freely cutting limestone	86	0
Rhætic 74 ft.	Pale grey limestone with pyrites	11	0
	Brown and grey clays and black shales—*Av. contorta*, *Pecten Valoniensis*, and fish teeth	33	0
	Grey and blue marls and sandstone	30	0
Keuper Marls 17 ft.	Green and red marls, with hard bands	15	0
	Red marl and sandstone, with gypsum at base	12	0

As the Upper Lias in this district may be estimated at 120 ft., the total thickness of the Lias here is 1360 ft., which is the maximum known.

In a boring south-east of Rugby 458 ft. of lowest Lias was met with. The outliers at Needwood Forest are composed of Rhætic beds; a list of 21 fossils is given from the *angulatus* and *semicostatus* zones at Whitchurch, in Shropshire; the *Lima* beds also occur at Audlem, in Cheshire; in Cumberland the *planorbis* beds are fossiliferous, but the presence of Rhætic beds cannot be verified.

Chapter VII. Middle Lias.—The total thickness of the zones of *A. spinatus* and *A. capricornus* in Dorsetshire is 345 ft.; in Somerset, a few up to 230 ft.; in Gloucestershire, 60–280 ft.; and in Northants and Lincolnshire, 150 ft. It is noted that species "identified by some authorities" as *A. annulatus*, *communis*, *crassus*, *Holandrei*, *serpentinus*, etc., have been obtained from the Marlstone Rock bed; but as "the species of old authors (unfortunately) are split up more and more into other so-called species and 'mutations,' great difficulties attend all identifications." In the Dorsetshire section the 345 ft. are divided into 11 groups, the lowest being the "three tiers"; above comes the Starfish bed, and at the top 9 in. of marlstone. The junction bed with the Upper Lias is made up of two layers, separated by a ferruginous seam; in the upper 16 in. there are Upper Lias ammonites, and in the lower 8 in. those of the Middle Lias, but the author states that Upper Lias forms are "said" to occur throughout. This bed may be seen in the brickyard north of Allington [*see* No. 125, 1891], but the other subdivisions cannot be traced inland. At Ilminster the uppermost band of marlstone is separated from the main mass by a few inches of sandy marl.

Chapter VIII. Middle Lias—Oxfordshire, Northants, and Warwickshire.—At Fawler ironstone is worked. In this district the "Transition bed" or zone of *Am. annulatus* begins to be important, and 46 species are recorded from it at Chipping Warden; it corresponds to the *Pleurotomaria* bed of the Dorsetshire coast. At Grantham the rock bed is 27 ft. thick, the total Middle Lias being 150 ft., but at Great Sowerby the rock bed is only represented by a layer of phosphatic nodules. The last place where ironstone is worked is at Caythorpe, and further north the marlstone degenerates, and is sometimes almost lost, or represented, as near Wellingore, by a nodule bed; but by Lincoln the rock bed sets in again. At Prees, in Shropshire, the occurrence of marlstone is verified, and 31 fossils from it are recorded.

Chapter IX. Upper Lias—general description.—There is no real palæontological break between the Middle and Upper Lias. If we exclude from the latter the sandy *jurensis* beds, the total thickness in Dorsetshire is 70 ft.; in Gloucestershire,

100–200 ft.; in Oxfordshire, 30–100 ft.; in Northants, 150–160 ft.; in Rutland, 176 ft.; in South Lincolnshire, 200 ft.; near Lincoln, 100 ft.; and further north it gradually reduces to 25 ft.

At Down Cliff, Dorsetshire, the Upper Lias shales graduate into the Midford sands, and as "*Am. radians*" has been found only 12 ft. from the bottom of the shales, it seems that the zone of *A. communis* is less conspicuously developed in Dorsetshire than elsewhere, and may be confined to the basement portion of the shales.

In Somersetshire, etc., the development is everywhere poor, and the distinction into zones not very certain. At Fawler, in Oxfordshire, *Am. annulatus*, *communis*, and *serpentinus* all occur in a 2–3 in. band immediately above the marlstone; and in a well near Bloxham the same three ammonites occur together.

Chapter X. Upper Lias—Northamptonshire.—The patches mapped as Upper Lias between Olney and Newport Pagnell are regarded as Great Oolite estuarine beds. The author considers that the nodules at the base of the Northampton sands at Moulton brickyard indicate a break, and, if the *jurensis* beds be present, they are only partially developed [*see* No. **221**, 1890]. In Lincolnshire the outcrop is very narrow, being confined to the side of the escarpment, though the thickness there is 100 ft., and in a borehole at Hambleton 176 ft. There is no evidence of the unfossiliferous zone of Northamptonshire, but the basement beds are recognized at Scalford, and the whole at Grantham.

Chapter XI. Economic Geology.—The only good building stone of the Lower Lias is that of Sutton, and a similar rock at Shepton Mallet, but the marlstone is worked in Somersetshire and at Edge Hill, where it is called Horton stone. Ochre has been worked at East Harptree in the cherty beds of the Lower Lias and Rhætic. The other minerals noted are: mica, galena, blende, manganese ore—at Frocester and Ilminster, specular iron, iron pyrites—causing spontaneous combustion on the Dorsetshire coast, selenite, calcite, barytes, and quartz.

Chapter XII. Economic Geology: Agriculture, Springs, etc.—Under this head are notices of drift deposits, soils, terraces of cultivation or lynchets, distribution of population, water-bearing strata, reservoirs, springs, petrifying springs, chalybeate springs (21), sulphuretted springs (8), saline springs (35), most of the last being in the Lower Lias. In an appendix is given a catalogue of fossils. The names have been derived from published sources and the necessary additions made, but, as a whole, they have not been submitted to a critical examination, hence a summary only is here given. They include: Reptiles 32, Fishes 80, Cephalopoda 205, Gasteropoda 290, Scaphopoda 8, Lamellibranchiata 270, Brachiopoda 88, Polyzoa 8, Crustacea 37, Insects 56, Annelids 17, Echinoderms 41, Corals 95, Sponges 4, Foraminifera 99, and Plants 19.

OOLITES.

*153. Buckman, S. S.—The Bajocian of the Sherborne District: its Relations to Subjacent and Superjacent Strata.

Quart. Journ. Geol. Soc., vol. xlix. pp. 479–521.

The author would prefer that such terms as "Bajocian" should express particular portions of past times, as indicated by the developmental phases of ammonites, and that they should only be indirectly applied to such strata as might be deposited during that time. The word zone being a strictly stratigraphical one, the name "hemera" is proposed for palæontological purposes "to mark the acme of development of one or more species," all the species met with in a zone not being necessarily in the fullest sense contemporaneous. The strata dealt with in the present paper were deposited during at least twelve hemeræ, which the author names as follows, in descending order:—

1.	Fuscae { A.	7.	Sauzei, J.
	{ B.	8.	Witchelliæ, sp., K.
2.	Zigzag { C.	9.	Discitis, L.
3.	Truellei, D.	10.	Concavi, M.
4.	Garantianæ, E, F.	11.	Bradfordensis, N.
5.	Niortensis, G.	12.	Murchisonæ, O.
6.	Humphriesiani, H, I.		

Of these hemeræ, Nos. 1–4 were formerly included in the *Parkinsoni* zone; Nos. 5 to part of 8 in the *Humphriesianum* zone; part of Nos. 8–10 in the *Sowerbyi* zone; and Nos. 11 and 12 in the *Murchisonæ* zone; and, afterwards, Nos. 9 and 10 were separated as the *Concavum* zone. Seventeen sections, showing the deposits of these hemeræ, are then described. [With one exception only the ammonites quoted are here abstracted.]

Section I.—Stoford.

		ft.	in.
A to C.	6 beds without ammonites	3	10
D ?	Soft earthy stone. *Parkinsonia*, sp.	0	3
F.	2 beds. *Oppelia*, sp., in the lower	0	9
J.	Hard blue limestone with holes. "*Stephanoceras*" *Sauzei*, *Sonninia* aff. *Sowerbyi*	0	6
L ? M.	Blue and yellow stone with small iron grains. *Ludwigia rudis*, *Lioceras concavum* (loose)	0	8
O.	Hard blue centred limestone	1	9

Section II.—East Hill Quarry. Bradford Abbas.

		ft.	in.
A. } B. }	White limestone with *Oppelia* cf. *fusca*, *Oecotraustes conjungens*	6	6
C.	Yellow sandy stone	0	5
D.	Soft whitish limestone with *Parkinsonia Parkinsoni* ..	0	3

		ft.	in.
F.	The "Dirt" bed, the "Marl" bed, and another	0	6
J.	The "Irony" bed—limestone with holes. *Sonninia mesacanthus*, *Witchellia*, sp.	0	4
L.	Ironshot limestone *Sonninia* and *Hyperlioceras*	0	7
M.	Lighter ironshot limestone. *Lioceras concavum*, *Ludwigia cornu*	1	4
N.	Soft yellow marl. *Lioceras bradfordense* and *L. v. scriptum*	0	1
O.	The "Paving" bed. *Ludwigia Murchisonæ*	0	5
	Two other beds	0	10
R.	The "Dew" bed. *Dumortieria Moorei*	0	11

In Section III., near the Vicarage, four bands of limestone, etc., without recorded fossils, are considered to show 10 ft. of the upward continuation of the Fuscæ beds—A and B.

Section IV.—Half-way House.

		ft.	in.
A and part B.	White limestone	25	0
A.	Limestone in two beds, the upper with *Oecotraustes conjungens*	7	10
D.	The "fossil" bed. *Parkinsonia dorsetensis*, *P. Parkinsoni*, *Strigoceras Truellei*	1	1
F.	"Marl" bed (not always to be detected)	0	1–2
F and G.	The "shell" bed, the "Rotten" bed. *Parkinsonia Garantiana*	0	4
H? J? L?	The "Irony" bed and another	0	10
M.	Blue-centred ironshot limestone. *Lioceras concavum*	2	7
N.	Similar limestone with *Rhynchonella ringens* and *Lioceras concavum*—and lower down ..		
O.	With *Ludwigia Murchisonæ*, *Lioceras bradfordense?*	0	10
	Hard grey limestone (underlain by yellow sands)	2	0

Section V.—Another quarry in the same locality.

		ft.	in.
M.	Beds with *Lioceras concavum*	3	0
N.	Ironshot limestone (two beds) with *Rhynchonella ringens*	1	2
O.	Soft bed	0	2

Section VI.—Louse Hill.

		ft.	in.
E.	Rotten and earthy stones	0	9-10
F and G.	"Astarte" or "Rotten" bed. *Parkinsonia Garantiana*, *Oppelia*, sp., *Ancyloceras*	0	5
H.	The "Irony" bed lying unevenly on the beds below *Stephanoceras* cf. *Humphriesianum*, "*S. Brackenridgii*," *Sphæroceras Brongniarti*, *Pœcilomorphus cycloides*	2	3
J or L.	Bluish-yellow ironshot limestone passing into	0	5
L.	The same with *Hyperlioceras*, *Sonniniæ*, and *Lytoceras confusum* in the lower part	0	10
M.	The same with *Lioceras concavum*, *Ludwigia cornu* ..	1	2
N.	The same with *Rhynchonella ringens* near the bottom	1	6
O and P.	Limestones, etc.	3	10

The next section is 1½ miles north, and shows a great difference.

Section VII.—Marston Road Quarry.

		ft.	in.
N.	Soft yellowish limestone with *Rhynchonella ringens*, *Lioceras bradfordense*, *Ludwigia cornu*	2	0
O.	Soft grey limestone with *Ludwigia Murchisonæ* ..	4	6
P.	Hard grey crystalline limestone, *Ludwigia Murchisonæ*, *Tmetoceras scissum*, *Lioceras opalinum*, *Erycites gonionotum*	1	6
Q.	Sand and limestone	5	0
R.	Yellow sands (Yeovil)		

Section VIII.—Holway Hill.

		ft.	in.
	Limestone with *Belemnites* (18 in.) and grey earthy parting	2	3
N.	Limestone 2 ft. and earthy parting. *Rhynchonella ringens*	2	3
O.	Hard grey limestone. *Ludwigia Murchisonæ*	6	6
P.	Sandy limestone. *Ludwigia Murchisonæ*	3	0
Q?	Sand		

Section IX.—Sandford Lane Quarry (Combe).

		ft.	in.
E.	Irregular lumpy limestone. *Perisphinctes triplicatus* ..	12	0
F.	Limestone in 5 ft. block, sandy limestone, etc. *Parkinsonia*	13	7
J and K.	The "fossil" bed. In the upper part *Sonninia patella*, *S. propinquans*, *S.* (of *Zurcheri* group), *Steph. Sauzei*, *Oppelia* aff. *præradiata*, *Steph.* cf. *Humphriesianum macer*, *Witchellia læviuscula*, *Strigoceras*, sp. In the middle part *Sonninia pinguis*, *S. gingensis*, *S. gracililobata*, *Witchellia*, sp., *Sphæroceras* aff. *Manseli*, *Sp. Brocchi*, *Sp. Sauzei*. In the lower part *Steph.* aff. *Sauzei*, *Sphæroceras Brocchi*, *Sonninia Stephani*, *S. rudis*, *S. fissilobata*, *S. arenata*, *S.* aff. *Sowerbyi*, *Witchellia Sutneri*	1	9
	Sand	0	1
L.	Greenish grey sandy limestone. *Sonninia ovalis* ..	0	6
	Brown sandy parting. *Hyperlioceras discites* and *H. Walkeri*	0	5
	Grey sandy stone. *Hyp. discites*	0	4
M.	Grey sandy stone. *Lioceras concavum*, *Ludwigia rudis*, *Sonninia*	0	11
	Earthy parting (3 in.), grey sandstone. *Lioc. concavum*, *Lud. cornu*, *Sonninia crassispinata*	2	3

The fauna of the lower part of the "fossil" bed, as a whole, is peculiar to it. In this bed the *Sonnininiæ* pass from their acme to their paracme. Above it there is a geological gap.

Section X.—Lime-Kiln Quarry, Combe.

		ft.	in.
D.	Rubbly beds. Grey shelly limestone, with fossils ..	1	2
E.	Shelly and earthy limestones. *Ancyloceras*	15	0
F.	The "Building Stone"	15	0
	Parkinsonia Garantiana, *P. dorsetensis*, *Strigoceras Truellei* (loose)	12	0

Section XI.—Red-hole Lane, Sherborne.

		ft.	in.
D and E.	Rubbly limestones. *Oppelia*, *Perisphinctes triplicatus*, *Parkinsonia Garantiana*, *P. præcursor*, and *P. rarecostata* (loose)	20	0
F.	The "Building Stone"	25	0

Section XII.—Clatcombe.

		ft.	in.
E.	Grey irregular limestone. *Parkinsonia* inter *rarecostata* et *Parkinsoni*	3	0
	Similar limestone (20 in.), earthy parting, *P. Garantiana* (3 in.), and yellow sandy limestone	3	7
F.	Yellowish limestone in two bands, the "Building Stone"	20	4

The ammonites of these rubbly beds are of an earlier biological type than those of the "fossil" bed of Half-way House, showing that 45 ft. of strata were here laid down, to 1½ ft. at the latter locality.

Section XIII.—Lower Clatcombe, by the new farmhouse.

		ft.	in.
D and E.	Shelly rubbly limestone. *Parkinsonia* aff. *præcursor*, *P. rarecostata*, *P. Parkinsoni*	10	0
F.	Five beds	22	3
E.	Ironshot, open textured limestone. *Parkinsonia Caumonti*, *Stephanoceras Braikenridgii*, *S. Banksii*, *S. Blagdeni*, *Parkinsonia niortensis*, *Perisphinctes Davidsoni*, *Sphæroceras*, *Oppelia*.	1	0
	Similar rock with *Steph. Braikenridgii*, *Oppelia*.. ..	0	5
	Earthy parting with *Oppelia* aff. *subradiata*	—	

Section XIV.—Clatcombe Farm. An opening specially made in order to find the Sandford Lane "fossil" bed below the *Humphriesiani* beds, which are not reached in the last section.

		ft.	in.
H.	Hard brown, ironshot oolite. *Pæcilomorphus cycloides*, *Steph. Braikenridgii*, *St. subcoronatum*, *Dorsetensia Edouardiana*, *Oppelia* aff. *subradiata*, *Oecotraustes* aff. *genicularis*, *Sphær. Brongniarti*, *Sp. Orbignyanum* ..	1	3
	Fissile oolite with flat top..	0	8
J.	Greyish brown, ironshot oolite. *Witchellia*, *Sonninina* aff. *S. Zurcheri*	0	7
	Yellowish limestone with numerous Gasteropoda. *Oppelia* aff. *præradiata*, *Sphær. Brocchi*, *Sonninia patella*, *Witchellia*	0	2
K.	Grey limestone with green grains. *Sphær. Brocchi*, *Stephanoceras*, *Strigoceras*, *Sonninia fissilobata* ..	0	2
	Bluish grey limestone, bored by annelids. *Sphær. Brocchi*, *Oppelia*	1	0
	Similar limestone	0	7
L.	Bluish grey, glistening limestone, bored by annelids. *Witchellia*, *Sonninia*, *Oppelia*	0	8
	Earthy parting	0	4
	Brown sandy limestone. *Hyperlioceras Walkeri*, *Ludwigia rudis*, *Witchellia*, *Lissoceras* cf. *Etheridgii* ..	5	0
	Four other beds, one with *Rhynchonella Forbesi* (a characteristic fossil of the Bradford Abbas "fossil" bed)	0	9

The fossils of the bottom bed of J and all of K show that these represent the Sandford Lane "fossil" bed.

Section XV.—Frogden Quarry—usually called Oborne Quarry.

		ft.	in.
F.	Various layers in two subdivisions	8	9
G.	Mixed hard and soft stone. *Oecotraustes cadomensis, Parkinsonia niortensis, P.* spec. nov., *Ancyloceras, Strigoceras*	1	0
	Hard brown, ironshot oolite. *Perisphinctes Davidsoni, Parkinsonia* aff. *Caumonti, Oecotraustes genicularis, Sphær. Brongniarti ?*	0	10
	Brown sandy limestone. *Parkinsonia, Sphær. Banksii, Perisphinctes Davidsoni*	1	4
H.	Brown, ironshot stone with *Belemnites*	1	0
	The same. *Steph. Blagdeni, Sp. Braikenridgii* ..	0	8
I ?	Hard greyish-brown limestone. *Oppelia*	0	7
J and K.	Soft, green-grained, white marl. *Witchellia Sutneri, W. læviuscula, Sonninia* aff. *patella, Steph. Sauzei, Sphær. Brocchi, Oppelia*	0	5
	Three beds below 1 ft. 3 in., and unseen 11 ft.	12	3
M.	Hard blue limestone. *Lioceras concavum*	2	0

The top bed of G is called by Mr. Hudleston the *cadomensis* bed. Bed H is the acme of *Stephanoceras*, and the last stage of the paracme of the *Sonnininiæ*. The soft white marl, J and K, is equivalent to part of the Sandford Lane "fossil" bed, but contains no fissilobate types of ammonite, nor the allies of *Sonninia Stephani*.

Section XVI.—Oborne. East of the village.

		ft.	in.
F ?	Yellow sandy limestone in blocks	20	0
E.	Hard shelly limestone. *Parkinsonia niortensis, P.* aff. *Garantiana, Oecotraustes cadomensis*	1	3
H.	Brown, ironshot limestone with green-grained lumps of marl in two beds. *Sonninia*	0	6
J.	White marl with green grains. *Witchellia læviuscula, Sphær. Brocchi, Stephanoceras*	0	4
K.	Hard bluish limestone. *Witchellia*	3	0

There may be erosion above J, but H is very thin here.

Section XVII.—Milborne Wick, Somerset. A road cutting.

		ft.	in.
F ?	Light yellow sandy limestone	8	0
H.	Soft white chalky limestone. *Steph. Braikenridgii, Pœcilomorphus cycloides, Sphær. Wrightii, Oppelia* aff. *subradiata, Dorsetensia liostraca*	0	4
	Grey limestone. *Steph.* cf. *subcoronatum, St.* cf. *Blagdeni, St. Braikenridgii*	0	6
J.	White limestone. *Sphær. perexpansum, Sp. Brocchi, St. Braikenridgii*	0	6
	Hard grey crystalline limestone	1	2
K.	Grey sandy limestone. *Witchellia, Sphær.* cf. *Brocchi, Sonninia* (all large)	13	2
L.	Two beds	2	6

K, which is correlated with the Sandford Lane "fossil" bed, is much thicker here.

It is claimed that these sections prove that beds which have hitherto been all bracketed together as belonging to the *Parkinsoni* zone, etc., as if they were contemporaneous, were in reality laid down at different times. The maximum amount of deposit formed during any one hemera is seen to shift from spot to spot. Thus the deposit during the *Murchisoni* hemera was greatest at Marston Road, that during the *concavi* and *discitis* at Frogden, and during the *Witchelliæ* and *Sauzei* at Milborne Wick. In these cases it is noticed that the most fossiliferous localities are a little west of the spots where the maximum deposit occurs; from this it is concluded that the maximum deposit during the *Humphriesiani* and *niortensis* hemeræ should be to the east of Frogden, where they are most fossiliferous. In these earlier hemeræ each succeeding maximum is shifted eastward, but in the later ones a reversal occurred, the maximum during the *Garantianæ* hemera being at Clatcombe, and that of the succeeding hemeræ at Half-way House, the mollusca congregating at Crewkerne, eleven miles W.S.W. of this. The sum of the maxima amounts to 130 ft.

The author next attempts to correlate the deposits at Dundry with the above, giving the following section :—

Section XVIII.—Top of Dundry Hill.

		ft.	in.
	Coral bed and building stone	25	0
J.	The "ironshot," the horizon of "*Ammonites Sowerbyi*" and "*A. corrugatus*," *Steph. Sauzei*, *Sonninia* cf. *propinquans*, *S.* cf. *mesacanthus* ..	1	0
K.	"White ironshot," the horizon of "*Am. laeviusculus*" and "*A. Browni*," *Witchellia*, *Sonninia Stephani*, *S.* cf. *fissilobata*, *Oppelia*	1	6
L and M.	Limestone and marl. *Lioceras concavum*, *Hyperlioceras*	6	0

He also gives details of deposits in the Cotteswolds, and makes the following correlations :—

	Fuller's-earth clay.
	Limestone beds above the *Clypeus* grit.
	Clypeus grit.
F ?	Upper *Trigonia* grit.
K.	Notgrove freestone. Gryphite grit.
L.	Sandy limestones. Lower *Trigonia* grit.
?	Harford sands.
N.	Upper freestone. Oolite marl.
O.	Lower freestone. Pea grit.
P.	Sandy ferruginous beds.
	The Cephalopoda beds.

The Gryphite grit and the Lower Trigonia grit in the Stroud district have hitherto been confounded together. The subdivisions of the contemporaneous French deposits, as established by Haug and Munier-Chalmas, are correlated as follows :—

Haug's zone of *Oppelia fusca*=A to C; his zone of *Cosmoceras subfurcatum*=E to G; his zone of *Sonninia Romani* =H; his zone of *Sphæroceras Sauzei*=J, K; his zone of *Harpoceras concavum*=L, M; and his zone of *Harpoceras Murchisonæ*=N, O.

Munier-Chalmas' zone of *Stomechinus granularis*=A to D; his zone of *Oppelia subradiata*=E to H; his zone of *Sonninia deltafalcata* is not recognizable in England; his zone of *Cœloceras Sauzei*=J; his zone of *Witchellia*, sp.=K; his zone of *Ludwigia concava*=L, M; and his zone of *L. Murchisonæ*=N, O.

It is pointed out, in conclusion, that two species lying side by side in a thin bed, are not necessarily contemporaneous, their proximity being due to the slow rate at which the surrounding sediment was deposited.

***154. Buckman, S. S.—The top of the Inferior Oolite, and a Correlation of the Inferior Oolite Deposits.**

Proc. Dorsetshire Nat. Hist. and Ant. F. C., vol. xiv. pp. 37–43.

The "Inferior Oolite" has mostly been considered to continue upwards till a clay bed is reached, and this bed was assumed to be always on the same horizon and called the Fuller's earth. This assumption, however, is not yet proved, and the author would like to see all such terms as Fuller's earth, Forest marble, etc., used in the same sense as Pea grit, Oolite marl, etc., and all of them included in the Bathonian, which should commence at the base of the *Parkinsoni* zone, where there are some signs of overstepping. An appended table shows the subdivisions of the Inferior Oolite which have been adopted by 18 successive authors.

***155. Woodward, H. B., Winwood, H. H., Wickes, W. H., and Wilson, E. — Excursions to Bath, Midford, and Dundry Hill, in Somerset, and to Bradford-on-Avon and Westbury in Wiltshire.**

Proc. Geol. Assoc., vol. xiii. pp. 125–140.

The "Midford sands" are taken stratigraphically to include the sands both of the Cotteswolds and of Yeovil. Locally the next overlying beds belong to the *Parkinsoni* zone. At Dundry all the zones of the Inferior Oolite, from that of *A. opalinus* upwards, are present. The Bradford clay belongs to the base of the Forest marble; at Bradford it is seen resting on the Great Oolite, but further south the latter subdivision, owing to local

erosion, is wanting. The Great Oolite at Murhill is compared with that at Ancliff, and is shown to have a similar development. At Westbury the following section is now visible, and shows one of the finest exposures of Corallian beds in the country.

		ft.	in.
Kimmeridge clay	Blue clay with *Ostrea deltoidea*		
Upper Corallian beds	4. Oolite ironstone = Abbotsbury ironstone	10	0
	3. Grey and brown sands, with seams of clay with *A. plicatilis*	4	0
	2. Rubbly beds of oolite, including the Steeple Ashton horizon	12	0
	1. Fine wedge-bedded oolite	10	0

CRETACEOUS.

156. Holmes, W. M.—On the Microscopical Structure of Hearthstone, from Bletchworth, Surrey.

Proc. and Trans. Croydon Micr. and Nat. Hist. Club for 1892–3, pp. 17–20.

The hearthstone contains particles of mica and rods of glauconite like casts from sponge spicules. There are also actual spicules and foraminifera. In the finest-grained parts may be found coccoliths and rhabdoliths. The rock belongs to the Upper Greensand, lying immediately above the Gault.

157. Kidd, H. W.—Detrital Character of the Lower Greensand of the Weald.

Science Gossip, 1893, pp. 147-149.

The pebbles in the Bargate stone are considered to have been derived from altered rocks in the West of England, but have in the meantime lain in older pebble beds. Pebbles of quartz rock and "palæozoic pebbles" are also found near Stockbridge, Charles Hill, etc., in beds above the Bargate stone.

158. Boulger, G. S., and Leighton, Thos.—On the Lower Greensand area to the North of the Rookery Fault, between Wotton and Dorking.

Proc. Geol. Assoc., vol. xiii. pp. 4–16.

The object of this paper is to correct some details of the Geological Survey Map which are considered to have an important bearing. In particular a section at the "rookery" at the west end of Westcott Heath shows ferruginous sands, which the authors regard as of Folkestone age, because the Bargate stone on the opposite side of the Pipp brook is dipping in this direction. The section lies, however, in the area mapped as Hythe beds. Other sections show also sands

which are referred to the same horizon, and at the corner of Coldharbour Lane there is an inlier of Hythe beds. A pit at Rokefield shows the junction with the Gault. It is suggested that the Bargate stone may be the western equivalent of the Sandgate beds, which cannot otherwise be recognized in the district.

159. Boulger, G. S., and Leighton T.—Excursion to Dorking.

Proc. Geol. Assoc., vol. xiii. pp. 140, 141.

The object of this excursion was to demonstrate the statements made in No. **158**. The supposed inlier of Hythe beds was found not to be in place, but to be part of a gravel deposit.

***160. Cameron, A. C. G. — Note on a Greensand in the Lower Greensand and on a Green Sandstone in Bedfordshire.**

Rep. Brit. Assoc. for 1892, pp. 710, 711.

Published in 1892 in the Geol. Mag. [*see* No. **130**, 1892].

***161. Leighton, T. — Excursion to Hythe, Sandgate, and Folkestone.**

Proc. Geol. Assoc., vol. xiii. pp. 142–151.

The bottom of the Sandgate beds has been described as "clayey," and by others as "black sand"; and the author considers the latter description an error. The excursionists pronounced the material to be a stiff loam—the land over it is very heavy to work. At Sandgate a *Paludina* shale was found at some depth below the Hythe beds, indicating the presence of the Wealden. The author considers that the evidence of the fault [*see* No. **63**] cutting the shore east of the outcrop of the Hythe beds is conclusive, as the repeated exposure of these beds could not be otherwise accounted for.

162. Farrar, A.—The Coast between Eastbourne and Folkestone.

Trans. Leeds Geol. Assoc., part viii. pp. 48–52.

A general description of the Cretaceous rocks.

***163. Hume, W. F.—Chemical and Micromineralogical researches in the Upper Cretaceous Zones of the South of England.**

London, 8vo, p. 103, with 3 tables. Printed privately.

The author has examined samples of chalk from the South of England—by treating them with 20 % hydrochloric acid—and has found the following residues:—

1. Chalk Marl.

Culver Cliff: Clay 39·039, and heavy residue ·767 per cent. The following foraminifera are present:—

Placopsilina cenomana.	Bulimina brevis.
Textularia trochus.	——— obtusa.
——— turris.	——— variabilis.
——— agglutinans.	——— Murchisoniana.
Tritaxia tricarinata.	——— Presli.
——— pyramidale.	——— Orbignyi.
Gaudryina pupoides.	

also lithistid and hexactinellid sponge spicules, and glauconite grains, quartz, jasper, apatite, rutile, tourmaline, zircon, and garnet.

East Wear Bay, Folkestone: Quartz, felspar, brown hornblende, rutile, and zircon.

2. Grey Chalk.

Culver Cliff: Clay 44·090, and heavy residue ·765 per cent.

Textularia agglutinans.	Bulimina variabilis.
——— minuta.	Haplophragmium agglutinans.

also glauconite, pyrite, quartz, and tourmaline.

Base of Warren, Folkestone:

Tritaxia tricarinata.	Ammodiscus incertus.
Textularia trochus.	

and iron concretions.

Glynde, near Lewes: Arenaceous foraminifera, quartz, and limonite.

3. *Belemnitella plena* zone.

Ballard Hole, I. of Purbeck: Clay 37·06, heavy residue ·471 per cent.

Ammodiscus incertus.	Haplophragmium.
——— charoides.	

also limonite, pyrite, glauconite, and quartz.

4. Melbourn Rock.

Ballard Hole: Clay 2·321, heavy residue ·025 per cent.

Ammodiscus incertus.	Textularia minuta.

also beekite, quartz, felspar, and limonite.

5. *Terebratulina gracilis* ZONE.

Culver Cliff: Clay 2·128, heavy residue ·112 per cent.

Ammodiscus incertus. Haplophragmium agglutinans.
Textularia minuta.

also limonite and rarely quartz.

6. CHALK ROCK.

Afton Down, Freshwater: Clay 1·800, heavy residue ·048 per cent.

Ammodiscus incertus. Tritaxia tricarinata.

also glauconite grains and rods, augite, hornblende, and tourmaline.

7. *Micraster cor-testudinarium* ZONE.

Ballard Hole, I. of Purbeck: Clay 3·537, heavy residue ·085 per cent., quartz, apatite, felspar, and tourmaline.

8. *Micraster coranguinum* ZONE.

Culver Cliff: Clay 2·499 or 1·188, heavy residue ·004 or ·003 per cent., also very minute glauconite rods and spherules, quartz, and organic fragments.

9. MARSUPITE ZONE.

Studland Bay, Swanage: Clay ·653, heavy residue ·01c per cent., also ferruginous grains of various shapes, and rarely quartz.

10. *Belemnitella mucronata* ZONE.

Culver Cliff: Clay 1·852, heavy residue ·005 per cent., *Ammodiscus incertus*, and grains of limonite.

Studland Bay, Swanage: Clay ·584, heavy residue ·003 per cent., limonite, quartz, and felspar.

The author then compares these results with previous records. The average percentage of heavy residue is in the Cenomanian ·539, in the Turonian ·019, and in the Senonian ·015, but both this and the main residue are more abundant in the Isle of Wight than at Folkestone. The foraminifera must have undergone secondary silicification to enable them so effectually to resist the action of the acid. The depths at which some of these are still found living indicates 350–500 fathoms as the depth of the Chalk Marl sea, which was probably of a sub-tropical temperature. The types remain the same throughout the argillaceous Cenomanian, but in the Turonian the *Ammodiscus incertus* becomes characteristic and is left alone in the Senonian.

***164. Jukes-Browne, A. J.—The amount of Disseminated Silica in Chalk considered in relation to Flints.**

Geol. Mag., Dec. 3, vol. x. pp. 541-546.

The statement that there is as much disseminated silica in non-flinty chalk as there is in chalk and flint together where the latter occur is here disputed, examples being cited where such is not the case. Thus, though in the Dorsetshire chalk there is indeed little silica where there are flints, in Wiltshire there is as much as 12 per cent. of colloid silica in flint-bearing chalk, while in the siliceous chalk of Collingbourn, Hants, there is 38·69 per cent. of silica to 30·77 of calcium carbonate. The Middle Chalk is pure, an analysis of a sample from Hitchin, where the flints are few, giving only ·35 per cent. of colloid silica. Two samples of Upper Chalk have been analysed: one with many flints from near Salisbury gave ·50 per cent. of colloid silica; the other with few flints, from the overlying Marsupite beds, gave none at all. These facts show that there is no definite relation between the presence of flints and the absence of colloid silica. It is suggested that the determining factor in the formation of flints is the presence of decaying organic matter at the time when the chalk was being deposited.

165. Hardcastle, C. D.—Chalk and Flint.

Trans. Leeds Geol. Assoc., part viii. pp. 14–24.

An elementary lecture.

***166. Abbott, G.—Was the Deposit of Flint and Chalk Contemporaneous?**

Geol. Mag., Dec. 3, vol. x. pp. 275–277.

The author wishes to maintain the following conclusions:—"1. That flint in the form now found was deposited[1] subsequently to the upheaval of the chalk above the sea-level. 2. That whilst the large quantity of siliceous sponge spicules present must have had a considerable share in the formation of the nodular, and perhaps of the tabular flints, yet quite as frequently various other hard substances and even empty spaces assisted. 3. That chalk flints grew after the manner of crystals (or concretions ?) and were regulated by similar laws." He notes that vein-flint is often in two layers which join in the centre.

***167. Jukes-Browne, A. J.—The Relative Ages of Flints.**

Geol. Mag., Dec. 3, vol. x. pp. 315–317.

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[1] The author now prefers the word "re-arranged"

This is in reply to No. **166**. The author says that the flint nodules and the tabular flint-floors must have been formed while the chalk was being accumulated. Flints of different layers have their own distinctive characters. Thus, the hollow ("cariés") flints of the zone of *Micraster coranguinum* have been formed round the sponge *Doryderma*. "In such nodules the flint must have been formed around, and attached to, the body of the siliceous sponge before its solution, and must have been as hard as it is now when the sponge tissue was dissolved out. The solution is not likely to have been accomplished until after the upheaval of the chalk; *ergo*, the flint was there before." "If the flint veins were formed after complete upheaval and by deposition from water percolating down from the surface of the land, it is difficult to understand where and under what conditions such water could first of all take up silica, and then deposit it as flint."

*168. Abbott, G.—The Relative Age of Flints.

Geol. Mag., Dec. 3, vol. x. pp. 477, 478.

A rejoinder to No. **167**. It is stated that the tabular flints are also in two layers.

169. Charlesworth, E. — On the enigmatical Flint-Bodies bearing the name of Paramoudra, and which are known only in the Chalk of Norwich and in the Chalk of Antrim.

Trans. Victoria Inst., vol. xxvi. pp. 209–219.

Issued as a separate paper in 1891 [*see* No. **370**, 1891].

*170. Abbott, G.—Potstones found near Seaford.

Nature, vol. xlviii. pp. 315, 316.

Notices the occurrence of a paramoudra on the shore.

*171. Bennett, F. J.—Notes on the occurrence of Chalk Rock near Marlborough.

Rep. Marlborough Coll. Nat. Hist. Soc., No. 41, pp. 60–64.

The range of the Chalk Rock is traced from Oldbury Castle and Rybury Camp, which are on outliers of Upper Chalk. At Oars Hill an anticlinal is seen, and the Giants Grave Hill is due to the occurrence of this rock. It is seen in the railway section at Hat Gate with a very high dip. On the north side of the Bath Road it bounds Leddington Castle on the south and east. It is then traced from Poulton Lane, round Row Down, at the College buildings, by Pickledean Barn, and in Overton and Waden Hills. The levels at which the Chalk Rock occurs demonstrate

a synclinal, corresponding to the Pewsey anticlinal, descending from 800 ft. to 500 ft. and then up again to 900 ft. above O.D. The only places where Melbourn Rock can be seen in the district are opposite Whitefield Farm, north of the road from Hat Gate to Wootton Rivers, and at a quarter of a mile due west of this.

TERTIARY.

***172. Holmes, T. V.—Excursion along the new railway from Blackheath to Bexley Heath.**

Proc. Geol. Assoc., vol. xiii. pp. 152–157.

In the section at Blackheath Park the pebble beds are seen in one place, but a little further on they have disappeared; the London Clay overlapping and resting directly on the Woolwich shell-bed, thus cutting out also the upper part of the Woolwich beds. North of Eltham Park the pebble beds have again the considerable thickness of 30–40 ft. North-east of the park they are covered by 20–30 ft. of London Clay. North-east of Welling a London Clay outlier is seen, and north of Bexley Heath the lower members of the Tertiary series successively appear.

***173. Abbott, W. J. L.—A new reading of the Highgate Archway Section.**

Proc. Geol. Assoc., vol. xiii. pp. 84–89.

The author describes various small sections made during building operations on the south side of Highgate Archway Hill. These show that the London Clay passes up gradually into iron-stained sands with London Clay fossils, of which about 50 are named. These sands are not Bagshot, therefore, but "sands of the London Clay." Above this comes a deposit of sand with angular fragments, which is considered to be either Southern Drift or derived from it. The apparent London Clay overlying this is, therefore, redeposited; and the author is not certain whether it may not be the washing down of the clay which was thrown out of the cutting when the archway was made.

***174. Monckton, H. W.—The Bagshot Beds of the London Basin.**

"Short Papers," pp. 27–32. Privately printed.

This is a reprint of the author's paper on the subject in the Quart. Journ. Geol. Soc., 1883, with some few additions. Amongst these are that these pebble beds occasionally occur in the Lower Bagshot, and that casts of shells have been found in the lower part of the Upper Bagshot sands, near Wellington College, a list of which was given in the Wellington Coll. Nat. Hist. Soc. Report for 1890.

175. Colenutt, G. W.—The Bembridge Limestone ("Binstead Stone") of the Isle of Wight.

Papers and Proc. Hampshire F. C., vol. ii. part ii. pp. 167–180.

A popular account. The Binstead limestone was last worked in 1876. Its outcrop along the northern shore is traced.

176. Dougall, J.—The Leaf-Caves of Mull.

Trans. Glasgow Geol. Soc., vol. ix. pp. 286–289.

An account of a visit to these well-known beds.

177. Bell, A.—Notes on the Correlation of the Later and Post-Pliocene Tertiaries on either side of the Irish Sea, with a reference to the Fauna of the St. Erth Valley, Cornwall.

Proc. Roy. Irish Acad., vol. ii. No. 4, pp. 620–642.

The oldest of the post-Pliocene deposits on either side of the Irish Sea is that of the shelly sands of Wexford, which contain 11 Pliocene and 16 boreal molluscs, two of which are recorded as new species. This is compared with the St. Erth's deposits, the molluscan fauna of which is being monographed by the author and Mr. R. Etheridge. A complete list of the shells therein to be described is here published in advance, including a number of MS. names of new species, of which brief notes are appended, not intended to serve as descriptions. The following is the list:—

Ostrea edulis.
——— plicatula.
——— ungulata.
Pecten Brocchii, MS.
——— plebeius.
——— opercularis.
——— pusio.
——— curvistriatus, MS.
——— divigatus, MS.
——— striatus.
Pectunculus glycimeris.
Limopsis minutus.
Nucula nucleus.
——— sulcatus.
——— proximus.
Cardium tuberculatum.
——— semituberculatum, MS.
——— echinatum.
——— Deshayesii.
——— Hornesianum.
——— papillosum.
——— minimum.
——— strigilliferum.
Lucina borealis.
Axinus flexuosus.
Cyamium minutum.
Cardita aculeata.
——— corbis.
——— striatula, MS.
Astarte parvula.
——— Macandrewi.
Woodia digitaria.
Montacuta truncata.
——— bidentata.
——— ellipsoides, MS.
——— pusilla, MS.
——— ovata.
Lasæa rubra.
——— pumila.
Kellia orbicularis.
Lepton nitidum.
Artemis exoleta.
Venus ovata.
Tapes aureus.
——— virgineus.
——— pullastra.
Venus multilamella.
Erycina longicollis.
Abra trigonula, MS.
Mactra solida.

Mactra subtruncata.
Thracia villosiuscula.
Mya arenaria.
Saxicava rugosa.
Solen ensis.
Lutraria elliptica.
Cypræa avellana.
——— affinis.
——— europæa.
——— dubia, MS.
Voluta St. Erthensis, MS.
Columbella erythrostoma.
Nassa serrata.
——— emiliana.
——— granifera.
——— granulata.
——— Touerneri.
——— semistriata.
——— recticosta.
——— Perrieriæ.
——— dertonensis.
——— mutabilis.
——— solida.
——— Warburtoni, MS.
Buccinum Jani.
Lachesis multilineata, MS.
Nesæa candidissima.
Murex funiculosus.
Fusus tentativus, MS.
Euthria cornea.
Pleurotoma Herndsii.
————— costatostriata.
————— costata.
————— brachystoma.
————— parvula, MS.
————— tenuicosta, MS.
Defrancia linearis.
Cerithium tricinctum.
———— reticulatum.
———— pseudoreticulatum.
———— crassicostatum, MS.
Cerithiopsis minima, MS.
Triforis adversum.
——— perversum.
Menestho basistriata, MS.
Turritella triplicata.
———— planispira.
Natica catenoides.
——— varians.
——— sordida.
——— millepunctata.
——— multipunctata.
——— consors.
——— proxima.
——— Beyrichii.
——— Montacuti.
——— Burtoni, MS.
Odostomia albella.
————— obliqua.
Odostomia acuta.
————— unidentata.
————— rissoides.
————— pallida.
————— turrita.
————— plicata.
————— Warreni.
————— conspicua.
————— insculpta.
————— striolata.
————— magna, MS.
Chemnitzia clathrata.
————— eximia.
————— euterpe.
————— plicatula.
————— costellata.
————— interstincta.
————— Warringtoni, MS.
Turbonella eulimæformis.
Aclis elongata, MS.
Eulima intermedia.
——— subulata.
——— polita.
——— Stalioi.
——— gracilis.
——— stenostoma.
Eulimene pendula.
———— terebellata.
———— bythiniæformis, MS.
Hydrobia ventrosa.
———— ulvæ.
Jeffreysia diaphana.
———— globularis.
Rissoa Ehrenbergi.
——— Montagui.
——— partimcancellata.
——— reticulata.
——— substriata.
——— intusstriata, MS.
——— semistriata.
——— fenestriata, MS.
——— pulcherrima, MS.
——— gracilicosta, MS.
——— densicosta, MS.
——— ovalis.
——— parva.
——— pentadonta.
——— membranacea.
——— soluta.
——— cingillus.
——— Whitleyi, MS.
——— Millettii, MS.
——— truncata, MS.
——— conuloidea, MS.
Lacuna suboperta.
Littorina cincta, MS.
———— gibbosa, MS.
Cithnia tenellæformis, MS.
——— fusca, MS.

GLACIAL AND SUPERFICIAL.

***178. Lomas, J., and Dwerryhouse, A. R.—The Glacial Deposits on the shore of the Mersey between Hale Head and Decoy Marsh.**

Proc. Liverpool Geol. Soc., vol. vii. pp. 80–87.

In this paper is the continuation of the description of the district dealt with in No. **143**, 1892. In the first bay beyond the lighthouse grooved boulders of Dalbeattie granite, etc., occur in the top of the soft Triassic sandstone, and further on are two boulders of diorite, one with the long axis vertical, forced into the sandstone. In the middle of the second bay there is a good example of a ground moraine, the angular fragments of the underlying rock being mixed with the rounded, travelled blocks. Nearer to Decoy Marsh there is a platform on the shore which, when swept bare by the tide opposite the Perch, shows the rock below the Boulder-clay to be striated in a north-west direction on the land side of the bosses, some of the grooves being 2½ in. across and 1 in. deep; the boulders are striated, or have their long axes in the same direction, and their upper surfaces are in the same plane as the striated rock-bed surface. Combining this with other observations, it appears that there is a gradual easting of the direction of striation towards Runcorn Gap. The boulders consist of 64·9 per cent. Lake District rocks, 1·5 per cent. Scotch, and 7·4 per cent. doubtful. There are also flints and boulders of eurite. The change in the direction of the striæ at Hale and Runcorn points to a splitting of the ice at Weston Point, one branch going up the Mersey valley and the other up the Weaver, the "buried valleys" of which are considered to have been scooped out by the moving ice itself.

***179. Lomas, J.—On a Glacial Mill at Arno Quarry, Birkenhead.**

The Glacialists' Magazine, vol. i. pp. 66, 67.

On the top of the hard Keuper sandstone in this quarry is seen a depression resembling a wash-hand basin. It is 33 in. in diameter and 18 in. deep; at the bottom there is a smaller one of 16 in. diameter at the top, and 12 in. at the bottom, and 8 in. deep. This is filled with a stiff sandy clay, and in the centre lies an andesite boulder 8 in. by 6 in., with its long axis vertical. The sides of the basin are smooth and horizontally striated. Near the same spot occurs another deeper basin, and both resemble the potholes seen on the Dingle shore. These phenomena are referred to the work of a glacier mill, at a point where the course of the ice was deflected.

180. Dwerryhouse, A. R.—An Intrusive mass of Boulder-Clay at Bidston, Cheshire.

The Glacialists' Magazine, vol. i. pp. 9–12, with two plates of sections.

The Boulder-clay at this spot, which is recognized by its containing scratched pebbles of andesite and Silurian grit, is said to occur in a long tongue below the Keuper sandstone, imbedded in a blue marl. There are also pockets in the rock of variously coloured sand. This Boulder-clay is thought to have been pushed in by an ice-flow coming from the north-west, and the sand, derived from the underlying Bunter, to have been pushed in with it.

181. Morton, G. H.—Intrusive Boulder-Clay.

The Glacialists' Magazine, vol. i. pp. 77–79.

In an adjacent excavation to that described in No. **180** the red marl, which resembles Boulder-clay, is only the Keuper marl. The stones in it have simply worked down from the surface of the ground.

***182. De Rance, C. E.—The Glacial Drift deposits at Sandbach.**

Trans. Manchester Geol. Soc., vol. xxii. pp. 235–237.

A new section in the railway cutting at Sandbach shows a very fine series of drift deposits, with "fluxion structure" and numerous small faults. There is much rolled coal, some showing glacial scratches.

183. Roeder, C.—List of Shells from the Lower Boulder-Clay at Heaton Mersey, near Manchester, with remarks thereon.

Trans. Manchester Geol. Soc., vol. xxii.

Below the peat here, at about the 150 ft. level, are about 13–15 ft. of finely laminated clays, in which two large pockets of sand have been noticed containing *Salicornaria*, *Lepralia*, and fragments of *Nucula*. The laminated clays themselves contain no organic remains or foreign stones. Below them come stiff clay, with gravel and small angular boulders of granite, Carboniferous limestone, Wenlock sandstone, etc., but very few of the local rocks of Triassic and Permian age. This clay is upwards of 27 ft. thick and contains:—

Turritella terebra.	Pleurotoma rufa.
Cardium edule.	———— turricola.
———— echinatum.	Trophon truncatus.
Tellina balthica.	Buccinum undatum.
Mya truncata.	Cyprina islandica,
Astarte compressa.	and other genera.

No united valves occur *in situ*, nor any shells encrusted with barnacles; the material inside the shells is the same as that outside. Only two shells are perfect, and no microzoa are found.

184. Watts, W.—Singular Nodules and Ice-Worn Stones found in the Boulder-Clay of Piethorne Valley.

Trans. Manchester Geol. Soc., vol. xxii. pp. 436–439.

In a recent excavation near Rochdale some curious nodules were found in the brick clay which overlies the Boulder-clay. They consist of hard oblate spheroids, with a hollow interior, containing a loose earthy ball or a fine impalpable mud. The author thinks these nodules to be due to acidulated surface waters. In the stony clay there are blocks of Millstone grit, each above a ton in weight, from Blackstone Edge, as well as boulders of mountain limestone.

***185. Tute, J. S.—The occurrence of a Tooth of Mastodon[1] in the Glacial Drift.**

Proc. Yorkshire Geol. and Polyt. Soc., vol. xii. p. 246.

The tooth was about 6 ft. from the surface in a bed of clay, grit, and stones which overlies a dark-coloured drift about a mile from Ripley.

186. Dale, Elizabeth.—On the Glaciation of the country round Buxton.

The Glacialists' Magazine, vol. i. pp. 111–113.

On the mountain limestone uplands several boulders of Lake District rocks have been found, but all of them obtained from walls. There are also boulders of local rocks, including one of toadstone. These, occurring between Buxton and Burbage, must have come from the north-east. It is thought that the ice must have entered the district *viâ* Chapel-en-le-Frith, and from thence have travelled in a south-easterly direction. The gravel terraces, however, are referred to river action.

187. Wright, G. F.—Supposed Inter-Glacial Shell-Beds in Shropshire, England.

Bull. Geol. Soc. America, vol. iii. pp. 505-508 (1892).

Shells have been found by the author and Mr. Baldwin at Ketley, near Wellington. They are referred to *Nassa reticulata*, *Turritella communis ? Dentalium*, *Lucina ?* and *Cardium ?* These occur in a gravelly stratum 2–3 in. thick, overlain by true till, and underlain by 25–30 ft. of sand. The elevation of this

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[1] Called "Mastodon" by error: "Mammoth" is intended (*auct. in litt.*).

deposit is 500 ft., but Dr. Crosskey has found shells of a more Arctic character at a height of 700 ft. in the same neighbourhood. The author does not consider that the occurrence of such shells indicates an inter-Glacial period, but gives general reasons for supposing that the bed forms part of the terminal moraine of the Irish Sea glacier, like those at Macclesfield, etc.

188. Deeley, R. M.—The Glacial Succession.

Geol. Mag., Dec. 3, vol. x. pp. 31–35.

The author discusses the succession made out by him in the Trent Basin in relation to the general succession of glacial deposits described by Dr. J. Geikie, noting that the earliest Boulder-clay of the latter corresponds to his Middle Pleistocene. He regards the Older Pleistocene as formed prior to the period of submergence which produced the high-level shell-beds, whose flints were brought from the east. He gives the following table [here reversed in order]:—

		9. Local moraines in mountain valleys.	Glacial.
		8. Britain again probably continental.	Inter-Glacial.
Newer Pleistocene	Lower Pennine Boulder-Clay.	7. Ground moraines, terminal moraines, etc., of British mountain regions.	Glacial.
	Inter-Glacial alluvium.	6. Britain again probably continental.	Inter-Glacial.
		5. Upper Boulder-Clay of Britain.	Glacial.
		4. Continental condition of Britain.	Inter-Glacial.
Middle Pleistocene	Chalky Gravel Great Chalky B.C. Melton Sand.	3. Lower Boulder-Clays of Britain, epoch of maximum glaciation	Glacial.
Older Pleistocene	Middle Pennine B.C. Quartzose Sand. Early Pennine B.C.		
		2. Forest bed of Cromer.	Inter-Glacial.
		1. Weybourne Crag, ground moraine of Great Baltic Glacier.	Glacial.

*189. Lucy, W. C.—Cleeve Cloud.

Presidential Address, Proc. Cotteswold Nat. F. C., vol. xi. pp. 6–13.

A pit near the summit of Cleeve Cloud shows clays, sands, and masses of quartzite, represented in a figured section as showing stratification. "The hole is a depression in the oolite, and the quartzose sand with the large boulder in it belongs to the period of the great submergence." This at a height greater than 750 ft.

190. Kendall, P. F.—Supposed Erratics on the Cotteswolds.

The Glacialists' Magazine, vol. i. pp. 97–99.

The author discusses the character of the sands and blocks described by Mr. Lucy in No. **189** as erratics. He considers they are not of drift origin, but Jurassic rocks *in situ*, for the bedding planes of the blocks are parallel to the general stratification, and "thin horizontal layers of clay can be seen to run continuously through the supposed erratics and the sand in which they are imbedded." In a second pit the quartzose sand is overlain by a massive bed of rock similar to that of the supposed boulder.

***191. Woodward, H. B.—Exhibition of Specimens.**

Proc. Geol. Soc., vol. xlix. p. 146.

These were striated specimens of *Elephas primigenius* and *E. antiquus*, the former probably derived from the contorted drifts below the chalky Boulder-clay of Norfolk; and of *Cervus Sedgwickii* from the Norwich Crag at Bramerton, not hitherto recorded below the Forest bed.

***192. Holmes, T. V.—The new Railway between Upminster and Romford: Boulder-Clay beneath old river gravel at Hornchurch. Conclusions therefrom.**

Essex Naturalist, vol. vii. pp. 1–14.

The author refers to his previous descriptions [*see* No. **184**, 1891, and No. **151**, 1892], and remarks that our only standard for the age of the deposits seen must be the chalky Boulder-clay. Now the Hornchurch gravel overlies this, and is therefore younger than it, and yet is at a higher level than any other Thames valley gravel in the district, and must therefore be the oldest of the Thames valley deposits, all of which, including the clays at Grays Erith, etc., must thus be post-Glacial. Amongst these he also includes the deposits which overlie the bed containing mammoth remains described by Dr. Hicks [No. **154**, 1892] at Endsleigh Street, which he considers to be simply river deposits, as they are only 80 ft. above O.D. and in all probability later in date than the Hornchurch gravel [*cf.* Introductory Review, 1892]. Their similarity to deposits at Finchley, which are five miles away and at a height of 200 ft., is no greater than to ordinary river deposits, "race" being found in deposits of various ages. The absence of well-marked terraces at Hornchurch is simply due to the underlying London clay being soft. The occurrence of the Boulder-clay at Hornchurch at a lower level than at Maylands three miles to the north has been considered to demonstrate that the Thames valley was commenced to be formed in pre-Glacial times; but the author

remarks that though there may have been a pre-Glacial valley more or less, as in other cases, coincident in places with the present, yet we know nothing of its deposits, those of the present Thames valley being all later than the chalky Boulder-clay.

193. Ulyett, H.—The Great Age of Ice.

Proc. Folkestone Nat. Hist. Soc. for 1892, pp. 12-20.

A general lecture on the subject.

*194. Monckton, H. W. — Geological notes in the Neighbourhood of Ongar, Essex.

Essex Naturalist, vol. vii. pp. 87–92.

The author first describes a pit at High Ongar showing dark earthy clay overlying yellow and white sands, which he agrees with Mr. Whitaker in regarding as Glacial Drift made up of Bagshot Sand, *i.e.* the sands are the remains of landslips which happened before the period of the Boulder-clay. On Coopersale Common a section showing clay overlying a mass of pebbles and small quartz grit is considered a good example of a pre-Glacial pebble gravel. Two sections on Kelvedon Common, one of which is new, which show flint and quartz pebbles with much sand, at levels of 308 ft. and 333 ft. above O.D., are thought to show the relics of a submergence between the Bagshot and Glacial periods, though the gravels have been subsequently rearranged. The gravels on the south of Norton Heath, at Nine Ashes, and at Stondon Massey are considered to be Glacial. The pit at Paslow Hill Farm shows Boulder-clay overlying Glacial gravel. The Cupsey brook also shows the underlying gravels; and near Greensted Church the Boulder-clay is seen above gravel. This gravel contains many flint pebbles, but no erratics, and is probably derived from some pre-Glacial gravels. There is gravel also in Naverstock Park, in which no erratics have as yet been found, and at Marden Ash chalky Boulder-clay. On the whole the author thinks that the Roding valley was excavated in pre-Glacial times.

*195. Reade, T. M.—The Drift Beds of the Moel Tryfaen area of the North Wales Coast.

Proc. Liverpool Geol. Soc., vol. viii. pp. 36–79, plates i.–viii.

The author first gives a short account of the physiography of the district. He then notes that the Boulder-clay in approaching a hilly locality is generally underlain by a stony deposit of more local and less glaciated rocks. On the coast at Dinas Dinlle sands and gravels are interstratified in an arched form with Boulder-clay: the gravels contain fragments of slate, and the bulk of the other stones are also of local origin; but the

smaller fragments, as shown by mechanical analysis, include granite, conglomerate, while the sands include polished grains of quartz. At the mouth of the Llyfni, further south, are boulders of Cambrian quartzose grit, felsite, dolerite, felspar, porphyry, and slate, all of local origin. At Gored Bruno, opposite Clynnog Fawr, the drift becomes more stratified, and on the shore there is a large boulder of blue Cambrian grit. Near Aberafon the drift contains shell fragments and small pebbles of many varieties of local or Welsh rock, with polished quartz grains. Further south there are stratified stoneless sands with pockets of boulder gravel containing fragments of *Cardium*. At Port Trevor 125 ft. of purple till are found. This contains many blocks of grey Carboniferous limestone with *Producti* and of Anglesey schist, Eskdale, and probably Ross of Mull granite. The smaller grains are also mostly of Anglesey rocks and of polished quartz. It is capped by boulder gravels. On the road to Nevin sands and gravels like those of the coast occur at 450 ft. and at 800 ft.; the gravel is angular and rotten, and is composed of the local felspathic rock, in which can be detected, by washing, some extremely rounded quartz grains. In Nevin Bay there is a stratified gravel lying on grey till, and further south there is a silty clay, without stones, but with shell fragments, and this is succeeded by contorted gravels. In the sands are many calcareous particles and polished quartz grains. Inland, at Pont-crych-ddwr, near Llanllyfni, typical till is seen at 400 ft. with boulders of Eskdale granite, Carboniferous shale, and Anglesey schist, and similar deposits occur on the banks of the Afon-ddu. At Pant Glas there are no stones in the till. On the right bank of the Llyfni, above the Woollen-mill, is a sandy clay 35 ft. thick, full of boulders and gravel with polished quartz grains. Near the Pen-y-groes station there is a large mound of drift, 600 yards by 200 yards, composed of rounded stones, with patches of Boulder-clay, and a circular mound, "evidently of drift," called Craig-y-dinas. Y Foel is drift-covered at the base, and a block of felsite is perched on the outcrop of the slate at the summit. At Tal-y-sarn a round disc-like stone of quartzite and other angular material occurs in gravelly drift.

The upper or south-west side of the Alexandra quarry at Moel Tryfaen contains Eskdale and grey granite, and a well-rounded pebble of a rock which both Mr. Harker and Mr. Marr identify as Shap granite "from one of the apophyses." This is the only example of this rock which he has found in Wales, Cheshire, or S.W. Lancashire during 20 years. Carboniferous limestone, Anglesey schist and flints are also noted, and some of the rocks are striated. On the north-east side the overlying till, containing a pocket of sand, may be seen; the boulders in this till are more local, and the smaller stones very numerous, including the Mynydd

Mawr rock, and well-rounded quartz grains; 400 or 500 yards to the east is a large felsite boulder. Among inland cwms Cwm Du has a talus-moraine, but the author knows of no trace of marine action in the Snowdonian valleys.

The rounded grains of sand found in so many of these deposits must be of marine origin, and it is noted that they occur even in the gravel of local origin at a height of 800 ft. on the Rivals. The pebbles in the high-level till are also rounded, and the material itself differs from that of Lancashire in being quite unstratified. The gravels of the coastal plain contain a greater proportion of local pebbles.

These observations show that the drifts of Carnarvonshire result from the work of two agents, one radiating from the Snowdonian group of mountains, and the other coming from the north. The local materials mostly accumulated at the foot of the hills and in the valleys, and they are more angular. Stratified beds are found near the coast and some way inland, and contain foreign blocks and very rounded sand grains, but the former are more numerous and yet water-worn in the high-level drifts. The author then argues that if the Moel Tryfaen drifts had been pushed up by ice, the coastal drift ought to contain as large a proportion of foreign blocks as the former. Their water-worn condition is also against their conveyance by land ice, as in that case they would have to have been carried without being scratched, or if the glacier ploughed up the old sea-bottom, the materials must have been previously deposited there by icebergs. The shells preserved in deposits in Lancashire, even at levels below that to which submergence is on all sides submitted, are fragmentary. Without submergence the author considers the phenomena to be inexplicable and unparalleled. He explains the presence of Anglesey schists at high levels "by pack-ice driven on to the north slope during the sinking of the land," and alludes to the well-known difficulty of accounting for the intercrossing of erratics from the Lake District and Scotland.

***196. Blake, J. F.—The Shell-Beds of Moel Tryfaen.**

Geol. Mag., Dec. 3, vol. x. pp. 267–270.

The author entirely disbelieves that these shell-beds have been formed in their present position during a submergence, and attempts to explain the process by which they may have actually reached this spot. There are seen in this district, bounding the west side of the Welsh hills, three parallel moraine-like mounds, the highest at 1100 ft. above O.D. These mounds are long, large, and full of foreign boulders, and the author has no doubt of their being termino-lateral moraines. "If the glacier could rise as high as this it would be a small matter to rise a little more." It is pointed out, however, that

the shell-beds are on the other side of Moel Tryfaen, and within the area usually occupied by local débris. The mass of which they form part is not moraine-like, but spreads out like a fan, dying away towards the west and south, but thickening to 60 ft. where it overlooks Bettws Garmon on the north. The foreign stones in these deposits are usually very small compared with the local ones. From these data it is concluded that the shelly sands were the first material to arrive in the district at the front of the advancing glacier, which pushed before it all the stones and shells which it found in the Irish Sea, the moraines first referred to, on the other, outer slope of the hill, being formed at a later date when the glaciers were retreating. The advancing glacier meeting with that which came out of Bettws Garmon at right angles, the resultant local pressure produced a rise in the ice above its average level and pushed it into the protected corner ready to receive it. Here on the east side of Moel Tryfaen it melted, and left the united débris behind, which from its protected position has not since been disturbed.

197. Kendall, P. F.—On a Moraine-like Mound near Snowdon.

The Glacialists' Magazine, vol. i. pp. 68–70, plate v.

This mound is crescent-shaped [with the concavity facing the cliff], and lies in the deep cirque-like Cwm Du on the north side of Mynydd Mawr. It has an altitude of 120 ft. above the general surface outside and 50 ft. inside [*i.e.* it stands on a slope]. It is considered that the intervening space between this mound and the cliff was formerly filled with snow compacted into ice, down the glacis of which the fragments of rock were carried and thus accumulated where now found. Their very unaltered condition indicates a comparatively very recent date for the production of the mound.

198. Peach, B. N., and Horne, J.—On the occurrence of Shelly Boulder-Clay in North Ronaldsay, Orkney.

Trans. Edinburgh Geol. Soc., vol. vi. pp. 309–313.

The authors have previously recorded the occurrence in several of the Orkney Islands of Boulder-clay with erratics such as can be most easily matched with Scottish rocks; they were, however, unable at that time to visit the most northerly island, North Ronaldsay. This want has been supplied by the late Dr. Traill, who found in trenches dug in the middle of the island some stiff red stony clay with boulders of the following rocks: granite, hornblendic granite, syenite, granitoid rock, felsite, hornblende-rock, gabbro, epidiorite, hornblende-schist, gneiss, mica-schist, quartz-schist, quartzite, crystalline

grit, vein-quartz, jasper, marble, Old Red Sandstone, conglomerate, flagstones and cornstones, volcanic ash, chalk flints, and fragments of chalk. Of these rocks only those from the Old Red are to be met with in the island itself. There are also rubbed fragments of marine shells, such as *Cyprina islandica*, etc.

199. Peach, B. N.—The Ice-Shed in the North-West Highlands during the Maximum Glaciation.

Rep. Brit. Assoc. for 1892, p. 720.

Evidence is brought forward that the ice-shed was at one time to the east of the present watershed. Thus, on Ben Fuaran there are boulders of Lewisian gneiss, which must have been carried westward out of the deep corries on the north-east slope of the Ben More range and left at a higher level. On the long ridge of Braebag there are westward pointing ice-scratches at a height of 2,000 ft., while on the crest and slopes there are blocks of Lewisian gneiss and Moine schist which must have been lifted from a lower level on the east. In the same way, in the neighbourhood of Loch Maree blocks of eastern schist have been found on the peaks and slopes of Squrr Bann, Corne Mac Fearcher, Ben Slioch, and Ben Eighe, so that at the time of maximum glaciation the ice-sheet must have overtopped these summits.

200. Hinxman, L. W.—On the occurrence of Moraines later than the 50 ft. beach in the North-West Highlands.

Trans. Edinburgh Geol. Soc., vol. vi. pp. 249-251, plate xi.

The moraine referred to occurs at the head of Loch Torridon, at the junction of Glen Torridon and Glen Traill. The moraine-stuff lies upon the 50 ft. beach, and is shown to have been deposited at a later date than it by the fact that the gravels of the beach contain rocks which are not found *in situ* within the watershed. These must have been derived from a Boulder-clay which once filled the valley, but which has been cleared away before the moraine was formed, especially as the latter sometimes rests on the solid rock. Glacial striæ, pointing down the valley, are recorded.

201. Bell, A.—The Glacial Fauna of King Edward, in Banffshire.

Proc. Roy. Phys. Soc. Edinburgh, vol. xii. pp. 20–22.

The clay in which the shells are found lies 200 ft. above sea-level, and contains numerous glaciated stones. The fauna indicates one of the later stages of the intensest cold of the Glacial period, the mollusca having their present habitats between the Arctic circle and Spitzbergen. Fifty-seven species

are noted, of which the following four are new as Scottish fossils and are not recorded in No. **177**.

Natica Alderi.	Pleurotoma ecarinata.
Pleurotoma abyssicola.	Lophohelia prolifera.

202. Crosskey, H. W.—The Clava Shell-Bed.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 277–285. (Read in 1887.)

The author asks a number of questions which he wishes the members of the society to answer. He considers the Clava shell-bed to be a true deposit and to indicate a subsidence of 500–600 ft. He adds *Astarte sulcata* to the recorded fauna.

***203. Coates, H.—The Cuttings on the Crieff and Comrie Railway.**

Rep. Brit. Assoc. for 1892, p. 717.

Practically published in 1892, in a paper read to the Perthshire Society [*see* No. **169**, 1892].

204. Kidston, R.—Note on two Glaciated Exposures of Trap Rock at Ballingrich Cemetery, Stirling.

Trans. Stirling Nat. Hist. and Arch. Soc. for 1892, pp. 114, 115.

The rock is a dolerite, and the grooves and striæ are almost due N.W. and S.E.; the overlying Boulder-clay has also scratched stones in it.

***205. Bell, D.—On the Alleged Proofs of Submergence in Scotland during the Glacial Epoch.**

Rep. Brit. Assoc. for 1892, pp. 713, 714.

The author suggests that the ice has come eastward from the sea at the northern end of Loch Ness, and has pushed up part of the sea-bottom.

***206. Bell, D.—On the Alleged Proofs of Submergence in Scotland during the Glacial Period. I. Chapel Hall, near Airdrie.**

Trans. Geol. Soc. Glasgow, vol. ix. pp. 321–344, with a plate.

The author considers that he has proved in a former paper [No. **214**, 1801] that the "great submergence" is a day-dream of the past, and he now proceeds to throw doubt on a submergence, even to the depth of 500 ft., at Chapel Hall. He points out that no *geologist* has seen the deposit which is said to contain the shells at that locality, but only some of the shells said to have been obtained, which were all of one species—*Tellina calcarea*. The whole story rests on the statement of a former

resident who sank a well at the place. Other borings close by shows that such a deposit can only occur within a small area, and the spot is near the summit of a watershed.[1]

***207. Bell, D.—On a Glacial-Mound in Glen Fruinn, Dumbartonshire.**

Trans. Geol. Soc. Glasgow, vol. ix. pp. 345–349, pls. xii., xiii.

This paper was published in 1891 in the Geological Magazine [No. **193**, 1891]. It is here illustrated by three sketches.

208. Dunlop, R.—Note on a "Wash-out" in a Shallow Pit of the Drumshangie Coal Company, near Airdrie.

Trans. Geol. Soc. Glasgow, vol. ix. p. 320.

This shallow pit entered the Drumgray coal-seam at a depth of 33 ft. The ground was here very sulphurous, but on driving a mine into it there were found a number of rounded stones of the Carboniferous rocks of the district, together with a few foreigners; the matrix, however, is not the ordinary Boulder-clay but a very pure fire-clay, becoming sandy and gravelly at the base. There were no scratches on the stones, and the mass was full of fire-damp, which does not occur in the ordinary coal of the district.

***209. Shone, W.—The Submerged Forest at Rhyl.**

Chester Chronicle, Feb. 18.

The forest in question shows tree stumps and peat at a depth of 10 ft. below the high-water mark of spring tides. This lies on a blue *Scrobicularia*-clay, and this again on Boulder-clay, sand, and gravel. It is to the subterranean erosion of the last that the author ascribes the depression which has caused the submergence.

210. Reid, C.—Fossil Arctic Plants near Edinburgh.

Rep. Brit. Assoc. for 1892, pp. 716, 717.

Published in 1892 in the Geol. Mag. [*see* No. **168**, 1892].

***211. Dowker, G.—Thoughts in a Gravel Pit.**

South-Eastern Naturalist, vol. i. pp. 72–77.

An abstract of a popular lecture setting forth the generally accepted conclusions relative to the teachings of gravel as to its origin, position, and contents.

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[1] Subsequent operations have shown that there is no deposit of shells at Chapel Hall, so that their source need not be discussed.

***212. Reid, C.—Desert or Steppe conditions in Britain; a study in Newer Tertiary Geology.**

Natural Science, vol. iii. pp. 367–370.

The author thinks that instead of a Pluvial period we must predicate a period of great dryness in later Tertiary times. He finds that the mollusca which once inhabited this country, but do so no longer, viz. *Hydrobia marginalis*, *Corbicula fluminalis*, *Unio littoralis*, and several species of *Helix*, now live in sunnier and drier climates; while the Saiga antelope and some small rodents belong to the desert fauna of Central Asia. The contents of our surface soils show, also, that there has been much wind drifting, such as produced the loess of Central Europe. Under these conditions he endeavours to account for the enormous sheets of valley gravel we find, without calling in the aid of an exceptional amount of rain. If the climate were drier it would be more chilled by the increased radiation: thus the surface would be frozen, and a moderate amount of rain which was unable to sink into the ground, but had to flow over the surface, would have greater erosive power. He does not think that the association of flint implements with these gravels proves that they were laid down by rivers; for Palæolithic man were not fishers, so far as we know, but would more probably hunt over the hills. The gravels are the products of sudden floods, due to the freezing of the ground.

***213. Monckton, H. W.—On the Gravels near Barking Side, Wanstead, and Walthamstow, Essex.**

Essex Naturalist, vol. vii. pp. 115–120.

The author describes a section at Lamborne End 335 ft. above O.D., showing a drift of pebbles and loamy sand overlying Bagshot Sand, the former of which he regards as pre-Glacial. The Barking Side gravel contains eight enumerated kinds of pebble, mostly foreign to the neighbourhood, and is probably of the same age as the Hornchurch gravel. The author is "inclined to believe" that in the west-of-Essex part of the Thames valley the succession is:—

1. Brick earth of Ilford.
2. The sheet of Barking Side, Ilford, and Walthamstow gravel.
3. The Hornchurch gravel.
4. The chalky Boulder-clay.
5. The gravel of Buckhurst Hill and some near Loughton.
6. The pebble gravels of Epping Ridge and Lamborne End.

The gravels along the Lea valley contain various derived pebbles, probably from the glacial drift, of which seven kinds are noted. Special attention is drawn to certain small pebbles at Walthamstow which resemble those in the Bunter, and

to a pebble containing *Orthis budleighensis*. They are probably derived in the last instance from a northern source. There are also here and elsewhere pebbles of Lower Greensand chert, showing a flow of water from the south in early Glacial or pre-Glacial times.

214. Wilson, J. H.—Notes on the Gravel in Epping Forest.

Essex Naturalist, vol. vii. pp. 74, 75.

In the section at Copt Hall, Westleton shingle, with quartz pebbles of considerable size, together with large flints and blocks of hard weathered sandstone, is seen. Similar deposits, 15 ft. thick, occur at Earl's Path, High Beach. East of the Forest Hotel, Chingford, a similar deposit is overlain by 6 ft. of clayey sand containing only a few rolled flints. The gravel behind the Roebuck Inn, referred by Prof. Prestwich to the Bagshot, also contains rolled flints, some of which appear to have been derived from the Drift.

***215. Irving, A.—On Post-Eocene Surface Changes in the London Basin.**

Geol. Mag., Dec. 3, vol. x. pp. 211–220.

Since 1883 the author has considered all the stratified gravels of the higher parts of the London Basin to be of fluviatile origin. There is a difference of opinion, however, between himself and Mr. Monckton as to the inclusion of certain gravels, *e.g.* the contorted gravels at Nine Mile Ride, as "glacial." The author uses that word in a structural sense, and thus includes gravels which may not be of "Glacial" age, as indicated by their containing pebbles derived from the Midlands. He has not included the Harford Bridge gravels among the plateau gravels because they show no sign of stratification and may be mere talus products from some older plateau gravel. During the long interval since the latter were laid down many mineral changes may have occurred, such as the production of limonitic masses and the formation *in situ* of glauconitic grains, the presence of which latter are therefore no proof of the derivation of certain gravels containing them from Middle Bagshot beds. Indeed, at North Court, Finchampstead Ridge, "it is almost impossible to doubt" that this *in situ* production of glauconite has taken place, the glauconite occurring in pipes and sporadically in admitted Upper Bagshot beds.

The author then deals with sands belonging to the gravel series, which may easily be mistaken for Bagshot Sands. Such are some sands in the Walton cutting and at Bracknell, where they contain angular flint detritus, and are pre-Glacial, *i.e.* are overlain by a "Boulder-clay," in which (as also

at Kintbury) the pebbles belonging to the Glacial series are vertical, a position which will be taken when "the pebble is itself moving in obedience to the law of gravitation through still water." The pipeclay in the sands at Lawrence's Brick-yard, north of Bracknell, the author considers "more than likely" to be "the insoluble residue of ice-borne chalky detritus," and thus to indicate a lacustrine origin for the deposit. Finally he describes a section at York Town, where Upper Bagshot Sands are overlain by an oblique talus of reconstructed plateau gravel; and by the side of this, so as to overlie it in part, is a mass of sand which is "a truly lacustrine deposit," but which, except for the inclusions and a small patch or two of fine flinty detritus, might easily be mistaken for Lower Bagshot Sand. Hence lithological identifications must be received with great caution.

***216. Shrubsole, O. A.—On the Plateau Gravel South of Reading.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 320–322.

The author has found white vein-quartz in the gravels of Easthampstead and Finchampstead, and purple quartzite, similar to that in the Tilehurst gravel at Chobham, 400 ft. above O.D. On Finchampstead ridges something like a Palæolithic implement, and a flake of brown flint showing a bulb of percussion, have been found. A large and highly finished Palæolithic implement has also been found at Wokingham 227 ft. above O.D. The author discusses the question whether the quartz boulder, etc., can be accounted for by predicating a submergence of 400 ft., but adopts no positive conclusion. At the reading of this paper Mr. **W. J. L. Abbott** mentioned his discovery of northern fossils and boulders in superficial deposits at Westcombe Park.

***217. Monckton, H. W.—On the occurrence of Boulders and Pebbles from the Glacial Drift in Gravels South of the Thames.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 308–319.

The object of this paper is to show where the Glacial Drifts, or their débris, are now to be found on the south side of the Thames. On the Tilehurst plateau the gravels from 290 ft. to 343 ft. above O.D. contain pebbles derived from the chalk and Tertiary beds of the locality, others derived from older gravels, others whose origin is doubtful, but which may be glacial erratics, and others which are certainly such, being of igneous rock, red quartzite, or ironstone. There is a similar gravel at a height of 275 ft. to the north of this, but the gravels on the south side of the Kennet belong to the Southern Drift.

Round Reading similar gravels occur, but on the 265 ft. plateau between that town and Shinfield there are no northern pebbles, but towards the south Lower Greensand fragments occur. Southern Hill, Reading, is thus the southern boundary of the Northern Drift gravel. At Bobs Mount northern pebbles, as red quartzite, a black stone, and a Neocomian rock, occur. At Sonning, 205 ft. above O.D., are flints, flint pebbles, quartz, red quartzites, ironstone, and Lower Greensand—a mixed set. At the 170 ft. level, north-east of this, a pit shows gravel with many northern pebbles, and no Lower Greensand. In some other pits nothing northern occurs. Above Bisham, at 351 ft., a section shows sands and gravels containing flints, flint pebbles, sarsens, subangular gravel flints, small and large pebbles of white quartz, black stone, red and brown quartzites, sandstone, quartz grit, and igneous rock, and nothing which is certainly from the Lower Greensand. Gravels with red quartzite occur at Cookham Dean at 300 ft. and on Warter Hill at 250 ft. Here also are lower gravels formed after the Thames had excavated the glacial gravels.

The gravels of Ashley and Bowsey Hills have been referred to the Westleton shingle, and are no doubt in part derived from it, but they contain occasional red-quartzite pebbles and fragments of black and grey chert, with crinoid fragments, indicating a northern origin, so that the limit of gravels with glacial materials must be drawn south of these hills.

South of Maidenhead the gravel at 150 ft. contains local, southern, and northern material, including a quartz conglomerate. West of Winfield Church the materials are all southern, so that the Thames here formed the boundary of the Glacial Drift. At Weybridge, Betcham, and south of Dartford there are no northern pebbles, but there are plenty at Kingston and Wimbledon, and also on Dartford Heath, one being a dolerite; at these places they are mixed with southern pebbles. These results confirm the conclusions arrived at in No. **159**, 1892, and show that the Kennet and the Thames were in existence when the Glacial Drift invaded the country though they have been much deepened since that time.

218. Bell, A.—Notes on a Post-Tertiary Deposit in Sussex.

Ann. Rep. Yorkshire Phil. Soc. for 1892, pp. 58–79, plate i.

The deposit referred to is on the shores of the Selsey peninsula. At the base comes a fluviatile gravel with beds of marl, containing fresh-water shells, then yellow estuarine clays, and then a hard mud, indicating deeper water. These beds seem to be part of the same deposits as those described by C. Reid in No. **157**, 1892. A long list of the fauna here discovered is given. It includes 8 Mammals, 2 Fishes,

6 Crustacea, 15 Ostracods, 216 marine Mollusca (including varieties), 92 of which are found also in the Crag, 10 land and fresh-water Mollusca, 18 Polyzoa, 4 Annelids, 3 Echinoderms, 53 Foraminifera, 1 Coral, 2 Hydrozoans, 1 Sponge, 1 Alga, and 3 Plants. The following Mollusca are not represented in the present British seas :—

Discoides bifissum.
Dentalium dentalis.
†——— candidum.
†——— panornium.
†Chiton siculus.
Fissurella costaria.
*Solariella acutangula.
*——— approximata.
Trochus turgidulus.
†Cyclostrema elegantula.
†Rissoa cimex.
†——— Montagui.
†——— deliciosa.
*——— scutula.
*——— bicarinata.
*——— multistriata.
*Cithna minima.
*Pecten scabriusculus.
——— Audouinii.
——— proteus.
†Kellia ambigua.
†Cardium papillosum.
*——— inæquale.
Cardium strigilliferum.
*Hydrobia compactilis.
*Barleeia cingulata.
Turritella incrassata.
Mesalia brevialis.
Odostomia elongata.
†Chemnitzia formosa.
†——— gracilis.
†Scalaria foliacea.
Adeorbis supranitida.
†Nesæa lineolata.
Pleurotoma Bertrandi.
†Ostrea lusitanica.
——— cochlear.
Pecten aratus.
——— flexuosus.
†——— hyalinus.
†Astarte pygmæa.
†Cardita trapezia.
†——— chamæformis.
Lucinopsis Lajori-Kacreanus.
Lutraria rugosa.
Tapes perovalis.

Those marked with a * are figured and described as new species [*see* No. **373**], and notes are given on those marked with a †; also on *Pecten polymorphus**, *P. testa**, *Micropora regularis**, *Diastopora regularis* var. *selseyensis*, *Gastrana fragilis**, *Otina otis**, *Noctus exasperatus**, *Rissoa striatula**, and *Aclis unica**. This fauna has a purely southern aspect, and some of the species are only known elsewhere in the Crag. The author speculates as to whence they came; he gives also lists of shells found in deposits on the cliffs in Pegwell Bay and near Sandwich.

***219. Reid, C.—A Fossiliferous Pleistocene Deposit at Stone, on the Hampshire Coast.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 325–328.

Last year the author described a mud deposit at Selsey [No. **157**, 1892], which indicated a mild period. He has now found a similar deposit covered by implement-bearing gravel, 20 miles to the west on the foreshore at Stone. Remains of an elephant's tusk show that this is a true Pleistocene deposit. It contains *Scrobicularia* and other shells, and several common British plants, but the most interesting relics are those of *Hydrobia similis*, now confined to the valley of the Thames, and *Acer monspessulanus*, a maple not now found nearer than

West Germany and the South of France, thus implying a warmer climate than at present. No good implements were found in the overlying gravel at this particular spot, but in their continuation, about a mile and a half to the north-east, a good Palæolithic flint knife has been found, a figure of which, with the spot where it was found, is given. This gravel is distinctly older than the Coombe rock.

***220. Shore, T. W.—Hampshire Mudlands and other Alluvia.**

Papers and Proc. Hampshire F. C., vol. ii. pt. ii. pp. 181–200.

Miscellaneous notes and discussions, showing the origin of the marine mudlands and inland alluvia.

***221. Bennie, J.—The Raised Sea-Bottom of Fillyside.**

Proc. Roy. Phys. Soc. Edinburgh, vol. xi. pp. 215–237.

The fossil contents of the clays have been examined. These consist of seeds of plants, 13 in number, and all common ones except *Montia fontana*; Carboniferous spores called Triletes i., ii., vi., xi.–xv., and Lagenicula i., and shells of common living species, so that no change appears to have taken place in the fauna since the sea-bottom was raised.

***222. Bennie, J.—The Raised Sea-Bottom of Fillyside.**

Proc. Roy. Phys. Soc. Edinburgh, vol. xii. pp. 26–28.

Lists of 20 Foraminifera determined by **D. Robertson,** and 25 Entomostraca, are here given as a supplement to No. **221**.

***223. Bennie, J., and Scott, A.—The Ancient Lake of Elie.**

Proc. Roy. Phys. Soc. Edinburgh, vol. xii. pp. 148-170.

Notes are given by the first author of the history of the discovery, occurrence, and relations of the shelly deposits in the old peat, as dug at four localities. The second author records, with notes, the 28 species obtained.

224. Bell, A.—On a Deposit in Largo Bay.

Proc. Roy. Phys. Soc. Edinburgh, vol. xii. pp. 22–26.

A previous paper on this deposit [Proc. R. P. S. Ed. vol. x. 1889] described some of its contents. To these are now added 34 species or varieties of Mollusca, special attention being drawn to *Montacuta truncata*, *Eulimene acuminata*, *Chemnitzia clathrata*, and *Odostomia interstincta* vars. *terebellum* and *suturalis*. A comparison of this deposit with that at Fillyside [No. **221**] is made, and they are shown to have 46 out of 155 species in common. The following species are

not known in any other post-Pliocene deposit in the United Kingdom than this at Largo:—

Aclis ascaris.	Odostomia truncatula.
Cæcum glabrum.	——— umbilicatula.
Cylichna umbilicata.	——— Warreni.
Eulimella scilla.	Pilidium fulorum.
Eulimene acuminata.	Pleurotoma striolata *var.* Metcalfei.
Lacula patula.	Rissoa abyssicola.
Odostomia clavula.	——— proxima.
——— obliqua.	Montacuta truncata.

A list of 33 species is also given, which are not known elsewhere fossil in Scotland.

225. Morris, D. B.—The Raised Beaches of the Forth Valley.

Trans. Stirling Nat. Hist. and Arch. Soc. for 1893, pp. 18–48.

The 50 ft. beach is first described: this varies from a few hundred yards to five miles in breadth, and has a length of 30 miles. It is by no means all at the same level above O.D., but rises towards the west at the rate of 1¼ ft. per mile, and laterally at 9 ft. per mile. The external boundary is a decided and rather steep slope, the western termination is a double bay, and the southern side is broad and semicircular. Near Craigarnhall Farm there is an old cliff of red sandstone, and the Abbev Craig at Spittal Farm is an old sea stack; the Ochils Hills there forming the sea-margin, which may be traced thence by Kincardine to Culross. On the southern boundary parts of Stirling stand on the beach, and the boundary terminates at Kinneil, near Bo'ness. Much of the surface is still covered with moss, and scarcely any villages or towns are built on it. The thickness of the deposits, including those on the surface, is variously stated as 161, 157, and 216 ft. References are given to lists of fossils recorded from the beach, but the remains of 12 whales named after the localities where they have been found receive special description. Notes are added of the implements, canoes, human remains, and kitchen middens of the beach.

The 100 ft. beach is more fragmentary, being always lost at the promontories. The Lake of Monteath, the Bridge of Allan, parts of Alloa, Cambrisbarron, and the hills of Dunipace are on it or parts of it. Its level changes like that of the 50 ft. beach. Its inner boundary is then traced round the Lake of Monteath, by Thornhill, Bridge of Allan, where there is a steep cliff, Tallibody, Alloa, Culross, Bogside, East Grange, and Dumfermline. Similarly, on the south side it may be traced from Stirling to Larbert, Bonnybridge, and Falkirk. The material of which it is composed is clay, gravel, and sand, which passes under that of the 50 ft. beach; false bedding is very

frequent and some of the pebbles are large. They are mostly of the Highland series or of Old Red Sandstone. A few rare fossil remains indicate a cold climate.

***226. O'Reilly, J. P.—Notes on *Lithothamnion* met with in Deep Cuttings at the Mouth of the River Liffey.**

Proc. Roy. Irish Acad., vol. viii. pp. 223, 224.

This calcareous alga was found coating shells at a depth of 22 ft. below water-mark. It does not now live in the mouth of the Liffey.

227. Dunlop, A.—On Raised Beaches and Relled Stones at High Levels in Jersey.

Quart. Journ. Geol. Soc., vol. xlix. pp. 523–530.

On the side of South Hill, St. Helier, on the top of rock exposed in a railway cutting, a depression is seen to be filled with well-rounded granite pebbles, 6–8 in. long, mixed with brick earth, which becomes more abundant further up the hill. This is at a height of 120 ft. above high-water mark, and at a higher level the surface of the bare rock is water-worn. At lower levels on the same hill, brick earth containing bands of pebbles occurs: amongst these are "a certain number of well-rounded flints." Flint pebbles are found on the present beach on the southern and eastern coasts; but not in such a large proportion as here.

About two miles to the east of St. Helier, on sloping ground, about 40–60 ft. above high-water level, near St. Clement's Church, is a deposit of brick earth, some 15 ft. thick, with pebbles of fine red granite, the underlying rock being diorite, and the nearest granite a quarter of a mile away. A mile to the east, and also on the coast about 40–50 ft. above high-water mark, similar phenomena are seen. Rolled stones at the bottom of clay are also reported inland from heights of 200 and 240 ft. above high-water. These facts the author accounts for by a submergence of the island to a maximum of 130 ft., with a long rest at a level of 50–60 ft. lower than now. It was afterwards elevated, as witnessed by the submerged forests, to a greater height than at present.

***228. Collenette, A.—The Raised Beaches, Cliff, and Rubble Heads of Guernsey.**

Rep. and Trans. for 1892, Guernsey Soc. Nat. Sci. and Local Research, pp. 219–235.

The author first describes the occurrence of beach pebbles in caves at 5–23 ft. above high spring tides, and also in patches along the cliffs, mostly between 6 and 12½ ft. above high-water. These are not found in parts of the south side. These beach

stones lie in thin cemented bands of about 1 ft. in thickness on platforms of rock. Similar bands of pebbles have been found in many places inland in making excavations, cuttings, quarries, etc. These are classed in three series of localities, according to their height above *mean* sea-level in feet.

1st Series.	Mont Cuet ..	29·59	Fort le Marchant ..	23·85
	" " ..	23·17		
	Islet Quarry ..	26·53	Fermain	25·29
	Grande Rocque ..	26·27	Moulin Huet ..	24·46
	" " ..	24·28		
2nd Series.	La Moye ..	55·21	Capelles	54·51
	Grande Miellette	54·87	Noirmont	54·13
3rd Series.	Rouvet	75·10	Le Huray	64·96
	Rocque Manigay	68·36		

Sea-washed rock extends up to 76 ft.

The cliff-head is represented as a wedge-shaped mass, divided horizontally into different kinds of material, and the whole resting on a raised beach between the original cliff and the present face. In ascending order these divisions are: rubble, with angular and many large stones; sandy-clay and rubble, no large stones; rubble band, few large stones; good clay; and recent rubble. Similarly arranged deposits are found inland as rubble head, and ascend in places to levels of 300 ft. The author deduces from these observations a complete submergence of the island during the Recent period.

*229. Derrick, G.—Guernsey Clays.

Rep. and Trans. for 1892, Guernsey Soc. Nat. Sci. and Local Research, pp. 212–218.

Clays occur in veins as the result of the decay of granite rocks, and also as widely-spread superficial deposits. At the Vrangue a pit has been sunk in them to a depth of 20 ft., showing loam 4 ft., good clay 3 ft., sand 2 ft., and the remainder disintegrated rock. Flint pebbles have very occasionally been found in the clay, and the sands are very local. The clays appear in many cases to pass into the disintegrated rock, so the author is most inclined to consider them due to rainwash, but the wide distribution and the presence of flints tell against this theory.

230. De la Mare, C. G.—A glance at the Rocks of Alderney.

Rep. and Trans. for 1892, Guernsey Soc. Nat. Sci. and Local Research, pp. 236–238.

Notes of a short visit in which the author saw the raised beaches at a level of 25 ft. above the sea. He considers the Alderney grit to be of the age of the Gres Felspathique of Normandy and younger than the Jersey conglomerate.

BOULDERS.

231. Crosskey, H. W. — Twentieth Report of the Committee appointed for the purpose of recording the position, height above the sea, lithological characters, size and origin of the Erratic Blocks of England, Wales, and Ireland, reporting other matters of interest connected with the same, and taking measures for their preservation.

Rep. Brit. Assoc. for 1892, pp. 267–289.

The Yorkshire Boulder Committee report—A block of Jurassic sandstone near Market Weighton; a mountain limestone boulder near Winstead, Holderness; basalt at Rokeby and Thirsk; Shap granite near Barnard Castle; Carboniferous limestone near Thirsk; Brockram in Ribblesdale; Helmsgill lamprophyre at 470 ft. in Dale Beck; Ennerdale granophyre at Dewsbury and Wakefield; and Shap granite, Armboth quartz-felsite, and Carrock Fell gabbro at North Ormesby, Teeside.

A long series from the neighbourhood of Rochdale is then recorded by **S. S. Platt,** most of which are quite small, and the only known rocks with which some of them are identified are the Buttermere granophyre, Galloway granite, and Eskdale granite; but many are recognized as volcanic.

On the banks of the Mersey, between Dingle Point and Hale Head, 136 boulders are reported by **J. Lomas.** Most of them are large, and they are assigned to one or other of the following: andesite, Silurian grit, Criffel granite, Scotch granite, Dalbeattie granite, felsite, diorite, andesitic agglomerate, ash, grit, white sandstone, limestone, Yewdale breccia, Silurian limestone, basalt, and diabase. The list is continued by **A. R. Dwerryhouse** from Hale Head to Decoy Marsh. In this space 202 are recorded, mostly much smaller than those in the first list, and the only additional variety is Eskdale granite; many of them are planed and striated.

From Mid Worral 118 boulders are reported by **J. Lomas.** They are all small, and consist mostly of andesite, but include also Yewdale breccia, Scotch granite, Silurian grit, diorite, andesitic agglomerate, limestone, felsite, Buttermere granophyre, gannister, Dalbeattie granite. Two large boulders of andesitic agglomerate are found on Hilbre Island. At West Kirby Beach 25 boulders of the same kind of rock, all lying with the long axis pointing N. 10° W., are recorded by **W. Mawby.** At Woodley, with the usual Lake District rocks, occur two blocks of Ardwick limestone, the nearest outcrop of which is at Levenshulme; 16 small andesitic stones are reported by **J. Lomas** from near Hayfield, Derbyshire.

At Llanymynech Hill, near Oswestry, a block of argillite

at 650 ft., and at Crickheath a striated surface at 590 ft., the striæ running W. 12° S., are recorded by **A. C. Nicholson.** At Tremeirchion, St. Asaph, a piece of Ailsa Craig eurite is reported by **C. R. Barker.** In a gravel-pit at Worcester, **E. Gray** recognizes Buttermere granophyre, Welsh lavas and agglomerate, flint, Eskdale and other Scotch granites, Wrekin rhyolite, and Upper Llandovery limestone. In the Isle of Man boulders of biotite granite, andesitic agglomerate, grit, Dalbeattie and Loch Skerrow granite, diabase porphyry, and Arran pitchstone are recorded by **S. N. Harrison.**

***232. Tate, Thomas.—The Yorkshire Boulder Committee and its Sixth Year's work.**

The Naturalist for 1893, pp. 109–111.

The contents of this report are incorporated in the General Brit. Assoc. Report for 1892 [*see* No. **231**].

***233. Tate, T.—The Yorkshire Boulder Committee and its Seventh Year's work.**

The Naturalist for 1893, pp. 363–368.

No boulders can be found in the valleys of the Holme and Colne tributaries to the Calder, nor has any Scottish, Cannock Fell, Eycott, Skiddaw, Threlkeld, Armboth, or Shap rock been identified in the Calder valley; but Buttermere granophyres, Eskdale granites, and Borrodale andesites are numerous. Boulders of Shap granite and whinstone are recorded near Middleton in Teesdale, but they all occur in the valley of the Lune and none in that of the Tees. There is recorded also Shap granite near Masham, two miles west of Ripon, Egglestone, and Startforth; basalt near Rokeby and Thirsk; millstone grit at Topcliffe and near York; and dolerite near Skipsea.

***234. Platt, S. S.—Some of the results of the investigations into local Erratic Blocks.**

Trans. Rochdale Lit. and Sci. Soc., vol. iii. pp. 52–56, with a map.

At the Flag Quarries, Bacup, striæ are seen running N.W. to S.E. or N.N.W. to S.S.E. The author refers for details to his map and to Reports of the British Association, but notes that there is a considerable admixture of rocks in his district. A list of 370 boulders is given, classed under 19 heads, including Lake District, Carnforth, local Carboniferous rocks and flints (4).

***235. Reade, T. M.—Eskdale Drift and its bearing on Glacial Geology.**

Geol. Mag., Dec. 3, vol. x. pp. 9–20.

Part I.—The author first gives an account of the distribution of the Eskdale granite boulders from St. Bees to Macclesfield on the east and Nevin on the west. He then notes the locality of the parent rock, giving a geological map of Eskdale. In the valley itself and its neighbourhood there are several drifts and gravels, viz.: A basal drift, lying on the granite itself; high-level glacial gravels, up to 1600 ft., composed of fragments of the volcanic series; marine boulder and other drift, composed of angular to rounded blocks of the granite, with fine current bedded sand; and the drift of the plain from Santon Bridge to Calder Bridge—this last is "undoubtedly marine." Beyond Calder Bridge, towards Whitehaven, there is loamy red sand; also marine drift full of boulders and pebbles of St. Bees sandstone; and in the valley bottoms, at 145 ft. above O.D., containing rounded boulders and pebbles of St. Bees sandstone, which must have travelled at least four miles up the valley. Some perched blocks and moraines are also noticed.

Part II.—It is very striking to notice in the birthplace of the boulders so few signs of glacial action on the rock itself, "the surface of which is singularly jagged." The author cannot understand the wide dispersal of the erratics on the land-ice theory, as the moraines of known glaciers always travel in trains, often as regular as tram-lines; but the dispersal is easily explained by the help of water; the marine drift which occurs in Eskdale valley itself rises to 400 ft., and "cannot have been pushed up by land-ice from the Irish Sea against the general flow of the valley-ice," and there is no proof that this drift does not rise even to higher levels.

***236. Lomas, J. — On the Glacial Distribution of the Riebeckite Eurite of Ailsa Craig.**

Rep. Brit. Assoc. for 1892, pp. 707, 708.

This kind of rock has been found on the Isle of Man, on Moel Tryfaen, in Anglesey, at Liverpool, Garston, Hale Head, Dawlpool, and Birkenhead, and in the Vale of Clwyd. Assuming all these boulders to have come from Ailsa Craig, the author states that the rise necessary to reach 1,350 ft. at Moel Tryfaen is 1,140 ft. The author cannot believe that floating ice could have brought all these, as there is not a free intermingling of types.

***237. Cole, G. A. J.—Glacial Drift of the Irish Channel.**

Nature, vol. xlviii. p. 464.

Records the occurrence of small pebbles of riebeckite rock on the shore at Killiney, "doubtless derived from the glacial gravels of the coast," and also on the raised beach at Greenore.

*238. Madsen, V.—Scandinavian Boulders at Cromer.

Quart. Journ. Geol. Soc., vol. xlix. pp. 114, 115.

The author thinks he can identify three of the Cromer boulders with rocks from definite localities in Norway and Sweden, and the similarity is vouched for by other Norwegian and Swedish geologists. One of the boulders has a grey-violet ground-mass, in which are scattered crystals of felspar, sometimes rhombic in form, ¾ in. by ¼ in. This is identified with a rock near Christiania. The second has a greyish-brown ground-mass, with porphyritic crystals of white felspar up to ¼ in. long and also decomposed hornblende crystals. This is like a porphyry from Gronklett, in Dalarne. The third has a greyish-black felsitic ground-mass, with several small, sharp-edged, transparent crystals of quartz, up to a breadth of $\frac{1}{16}$ in. This is also like a rock in Dalarne.

*239. Harker, A.—Scandinavian Rocks in the English Boulder-Clay.

Geol. Mag., Dec. 3, vol. x. p. 140.

The author recognizes in the Holderness drift: 1. Augite-syenite, like the laurvikite from Laurvig. 2. Rhombenporphyr. 3. Saussurite gabbro, from the west coast of Norway. 4. Coarse red granite with much microcline and microperthite, like that described from the Christiania district. 5. Various grey granites with cataclastic structure, like those on the "Grundfeld." 6. Well-banded gneisses. 7. Various hornblende schists.

*240. Harker, A.—Norwegian Boulders in Holderness.

The Naturalist for 1893, pp. 1–4.

This is practically the same information as that contained in No. **239**. The augite-syenite shows broad cleavage faces of felspar and diallage-like augite; the saussurite gabbro shows dark-green hornblende set in complex saussurite; the granites show undulose extinction.

241. Spencer, J.—Glacial Boulders in Calderdale.

The Naturalist for 1893, pp. 75–79.

The boulders which occupy the bed of the Calder have undoubtedly come from the western coast by Galloway, the Lakes, etc., and must have passed over the Pennine Chain. The question is, where did they cross it? In the two lower passes at the head of the Calder valley, those of Walsden and Cliviger, there are no boulders, but on the slopes of the hills on the south they are abundant. Hence it has been argued that the passes themselves must have been filled at the time with local ice, which offered a barrier against the great ice-sheet

and forced it to carry its burden over the summits in the neighbourhood.

242. Anon.—Record of New Boulders.

Caradoc Record of Bare Facts in 1892, p. 24.

Eskdale granite, ½ mile east of Church Stretton and at All Stretton; grey granite, at All Stretton; grey slate, ¾ mile E.S E. of Smethcote; basalt, ½ mile east of Lydham Heath station, and also 3 miles N.W. of Oswestry.

***243. Cameron, A. C. G.—Notes on a Transported Mass of Chalk in the Boulder-Clay, at Catworth, in Huntingdonshire.**

The Glacialists' Magazine, vol. i. p. 96.

The village is built on a mass of chalk with flints, some of which are tabular. Springs issue from the base of the mass, but the whole lies upon Boulder-clay, resting on Oxford clay, which is reached in some of the wells.

***244. Smith, J.—The Sand Hills and Torrs Warren, Wigtonshire.**

Trans. Geol. Soc. Glasgow, vol. ix. pp. 293–300.

Miscellaneous observations, mostly of an archæological character. Notes that many flint flakes are found here with some pieces of chalk, though none such occur in the Boulder-clay. It is suggested that the flint nodules may have come from Ireland with floating sea-weed.

***245. Bell, D.—The Granite Boulders of the Clyde Valley.**

The Glacialists' Magazine, vol. i. pp. 45–49.

The boulders of granite found in the Till of the Clyde valley have usually been referred to the mass at Ben Awe or Ben Cruachan; but the author considers that they must have been brought by ice-streams moving along valleys, and the streams from these hills would not reach the valley. Moreover, the direction of the striæ in the Clyde valley points to some place between Loch Lomond and the head of Loch Fyne as the source of the boulders. A granite was indicated here by Nicol in 1858, but it has been omitted in later maps until Sir A. Geikie's new geological map of Scotland. It is the same mass as that described by Messrs. Dakyns and Teall [No. **375**, 1892], and the boulders in the Till can be identified with various portions of it. A map is given showing the granite boss, the striæ, and the position of the boulders.

J. F. Jamieson, on p. 83, reminds the author that this granite boss was first discovered and considered to be the source of the boulders in question by Hopkins, Quart. Journ. Geol. Soc., vol. viii. 1851.

246. Livingston, C. — The Travelled Boulders of Lochaber.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 3–6. (Read in 1883.)

One or two boulders are briefly noticed, but their source is not discussed.

GLACIAL THEORIES.

***247. Geikie, J.—On the Glacial Succession in Europe.**

Trans. Roy. Soc. Edinburgh, vol. xxxvii. pp. 127–149, with a map.

It is assumed to be an admitted fact that there were two Glacial periods in this country, separated by an inter-Glacial period; and, starting from this, the author here endeavours to show that other cold periods, alternating with warmer ones, have both followed and preceded these. The Boulder-clay is looked upon as the "ground moraine" of a *mer de glace.* The maximum glaciation [which we may call A] is that which extended to the Thames valley. The second [B] extends only as far as the Midlands, and its results are most conspicuous on the surface in the North of England. The ice of this period was confluent with that of Scandinavia. In the mountains of Scotland there were large local glaciers of a later date. These the author now thinks were not merely the relics of B, but due to a recrudescence of glacial conditions, for the upper Boulder-clay of B only fills the valleys where there were no local glaciers, but where the latter have left their terminal moraines the older Boulder-clay of B is only left high up on the hill slopes, having been cleared out of the valleys by the advancing local ice [C]. These local glaciers often reached the sea, and to their agency the author ascribes the final scooping out of the lake-basins, and the completion of the deep depressions in the beds of the Highland fjords. Similar conditions must have obtained in England and Ireland. The Clyde beds being traceable back into moraines, it follows that they were laid down during a period of depression. There ought to be signs of an inter-Glacial period below these moraines, but none such have yet been recognized, and to prove the existence of such a period we must take into account the continental evidence. The Scandinavian ice had also two maxima [*a* and *b*]. During the first [*a*] it reached as far south as the Harz, and coincided with "the" *mer de glace* of the British Islands. During the second [*b*] it reached Berlin, and extended westward to Schleswig-Holstein, occupied all the fjords of Norway, "but did not advance beyond the general coast-line." Between the Boulder-clays of these two periods there are two peat beds in Holstein and one in Brandenburg which shows a temperate flora,

including the holly which no longer grows wild there. Previous to the first of these maxima we have evidence to show that there existed a great Baltic glacier, the ice of which trended nearly at right angles to the trend of the later ice. Now in Russia, near Moscow, it has lately been discovered that the long-known lacustrine formation with plants, indicating a milder and more humid climate than the present, lies between two Boulder-clays. But the glaciation of the second maximum [*b*], now referred to as "the great Baltic glacier" [but apparently not the same as that only just spoken of by the same name], did not reach as far as Moscow. Therefore these two Boulder-clays cannot be the products of the two maxima [*a* and *b*], known as the lower and upper diluvium, but must be on the horizon of the former alone, *i.e.* of the first glaciation [*a*]. Hence this cannot have been a single one. Thus, in Northern Europe there must have been really three Glacial epochs [a_{I}, a_{II} and *b*]. Now our Upper Boulder-clay [B] cannot correspond to the third of these [*b*], for it belongs to an epoch in which Scandinavian and British ice coalesced, whereas the great Baltic glacier [*b*] was limited to the coast of Norway. Thus, the great Baltic glacier [*b*] must be the equivalent of our local glaciation [*c*], while our first and second maxima [A and B] are on the horizon of the lower diluvium of Germany and the glacial deposit of Central Russia [a_{I} and a_{II}], and the inter-Glacial beds of the latter country represent what as yet we cannot find in Britain. It is probable, however, that this period may be represented here by some of our older alluvia, and by the clays with *Megaceros* below the peat bogs in Ireland. An account of one of these bogs at Ballybetagh is quoted from Mr. Williams. It is then noted that in the Alps and in France two or more Glacial epochs have been considered to be demonstrated by certain authors.

Returning to Scotland, it is stated that the disappearance of the local glaciers was accompanied by an elevation and union of Britain with the Continent. Then followed submergence and colder conditions, evidenced by the carse clays of the Firth of Tay, which contain occasional erratics. These are continuous with the 50 ft. beach, on which, in Arran and Sutherland, terminal moraines are seen reposing [compare No **200**]. To this last cold epoch several fresh-looking moraines at the head of the mountain valleys are referred [D]. These "conclusions are based on data which cannot be gainsaid."

These four British Glacial epochs were of continuously decreasing intensity; hence it is probable that the maximum was also reached by previous gradually increasing cold, though the results of such cold periods may have been cleared away by the later more important masses of ice. Indications, however, are Continent of such earlier cold periods in the

Inn valley, where the Hotting breccia, with a "Pontic" flora, lies on a moraine and contains derived boulders, and even in Britain the author thinks that the Cromer Forest bed may be interpreted as an inter-Glacial deposit on the Glacial Weybourne Crag [A_0].[1]

We thus have the following correlations:—

GLACIAL [A_0].—Weybourne Crag; ground moraine of great Baltic glacier.

Inter-Glacial.—Forest bed of Cromer; Hotting breccia; lignites of Liffe and Pianico; inter-Glacial beds of Central France.

GLACIAL [A].—Lower Boulder-clays of Britain; Lower diluvium of Scandinavia and North Germany (in part); Lower Glacial deposits of South Germany and Central Russia; ground moraines and high-level gravel terraces of the Alps.

Inter-Glacial.—Fresh-water and marine deposits.

GLACIAL [B].—Upper Boulder-clay of Britain; Lower diluvium of Scandinavia, Germany, etc. (in part); Upper Glacial series of Central Russia.

Inter-Glacial.—Fresh-water alluvia, lignite, peat, etc.; inter-Glacial beds of North Germany; marine deposits of Britain and the Baltic.

GLACIAL [C].—Ground and terminal moraines of mountain regions in Britain; Upper diluvium of Scandinavia, North Germany, etc.; terminal moraines in large longitudinal Alpine valley.

Inter-Glacial.—Fresh-water alluvia (with Arctic plants); Lower buried forests and peat; Carse clays and 50 ft. beach in Scotland.

GLACIAL [D].—Local moraines in mountain valleys in Britain, resting on 50 ft. beach; post-Glacial moraines in Upper Alpine valleys.

"In Scotland each Glacial epoch was preceded and apparently accompanied by partial submergence of the land."

248. Howorth, Sir H. H.—The Glacial Nightmare and the Flood.

London, Sampson Low, 8vo, 2 vols., p. 920.

This is a very long treatise designed to show that the Glacial theory as usually held is erroneous, and to substitute for it a theory of a great Pleistocene flood. The author commences with a long and interesting historical account of the views which preceded the Glacial theory. The later chapters are so full of argument on all kinds of questions relating to glacial matters, that due justice cannot be done to them in an abstract. First there is a discussion on the various causes assigned for the Glacial epoch, and he regards them all as inadequate. Next the author passes in review the theories that have been advanced to account for the motion of a glacier, and is strongly in favour of "Forbes' viscous theory," and, basing his views on this,

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[1] Perhaps also the early drift at Frankley Hill, near Birmingham. Compare also No. **188**.

argues that the phenomena recorded cannot be explained by the action of ice alone, but that water in some form is necessary. The last chapter is the only constructive one, the necessity for an exceptional and abnormal action of water being considered to be deduced by a process of exhaustion. This action is that of "a great deluge." All the phenomena are the results of a single cause acting in various ways, but not at different times. The continuous character of the deposits, the slope of the Glen Roy terraces, and the elevation of shell-beds where the passage is contracted, all require the flow of water. Such a flood would explain the mingling of marine and fresh-water shells and other remains, the occurrence of marine shells near the coast more than inland, the mixture of débris from various localities, the dependence of the character of the Boulder-clay on the underlying formations, the contortions and false bedding of the drift, the kames, eskers, and crag and tail, the variations in depth, and the great thickness of the drift. Scott Russell and Hopkins are then quoted as to the power of flowing water to move stones of large size, and Hopkins and Whewell on the amount of elevation of the sea-bottom necessary to produce a wave of translation of the required speed and size. The effects of various floods are then described, and such are said to be capable of accounting for the carrying boulders of Shap granite over Stainmoor Pass, for the divergence of boulders, for the driftless areas, for the elevation of blocks above their source, and for the striæ. The author finally expresses his agreement with "in some respects the greatest geologist who ever lived," in ascribing by far the greater part of the drift to waves produced by sudden vertical elevations, each not more than " 50 ft. in an ocean 300–400 ft. in depth."

249. Whitley, D. G.—The Ice Age and Post-Glacial Flood.

Scottish Review, vol. xxii. pp. 381–401.

A review of the two books, "The Mammoth and the Flood," and "The Glacial Nightmare and the Flood," by Sir H. H. Howorth, who is said to have "a complete knowledge of the scientific aspect of the case"; and the author in general agrees with him.

250. Kendall, P. F.—The Cause of an Ice Age.

Trans. Leeds Geol. Assoc., part viii. pp. 53–70.

An amplification of a paper read at the B. A. in 1892 [*see* No. **251**]. The author rejects as inadequate the terrestrial causes which have been relied on. Before discussing Croll's theory the author lays down the facts which he thinks have to be explained. 1. The Glacial period came on with extreme slowness, being foreshadowed in the Pliocene and Forest beds.

2. It was of long duration. This is estimated at 10,800 years by comparing the distance travelled by the ice front with the rate of motion of Greenland ice. 3. It passed away with extreme abruptness, as there are no moraines of retrocession. 4. The level of the British Isles was much the same at the outset of the Glacial period as at present, as seen by the old beach at Bridlington being on the present sea-shore. 5. The Glacial period is a very recent event, as estimated in America by the retrocession of the falls of Niagara and St. Anthony. 6. There has been but one Glacial period, no sign of any other being found in the strata of various ages in the Arctic regions. Now Croll's theory is inconsistent with all these conditions, except the fourth. The author argues against the existence of any inter-Glacial period, particularly against the evidence at Selsey offered by C. Reid. With regard to elevation, that which converted the St. Lawrence into lakes was only a local warping; and as to the fjords of Norway, if they were cut out of higher ground, the elevation must have long antedated the Glacial period. The requirement No. 4 is also quoted against this. The author then makes his own suggestions. He says we have to account for an equable climate down to the Cretaceous period, a steady cooling down to the Glacial period, and then a sudden increase of temperature at its close. The theory adopted is that of the sun being a variable star.

251. Gray, J. W., and Kendall, P. F.—The Cause of an Ice Age.

Rep. Brit. Assoc. for 1892, p. 708.

Abstract of No. **250**.

252. Ulyett, H.—Causes of an Ice Age.

Proc. Folkestone Nat. Hist. Soc. for 1892, pp. 21–25.

Abstract of a lecture explaining the astronomical theory.

***253. Geikie, J.—The Glacial Period and Earth-Movement Hypothesis.**

Journ. Trans. Victoria Inst., vol. xxvi. pp. 221–249.

The author considers that "geologists generally admit that there have been at least two Glacial epochs, separated from one another by one well-marked inter-Glacial stage," and recounts the European evidences that have led to this conclusion. Some of the river deposits beyond the glaciated areas are also known by their fauna to be contemporaneous with the inter-Glacial period. He then reviews the evidence bearing on post-Glacial climate, which was first more genial and then more cold and humid than at present—both changes being accompanied by geographical ones. He cannot accept the earth-

movement hypothesis, pointing out that the submerged valleys on the western border of the Atlantic and the Norwegian fjords are probably of great age, and that they were carved out by the water which still runs in them when the land was at a greater elevation. Again, we have evidence that the present seas, *e.g.* the Irish Sea, were in existence immediately previous to the Ice age. The elevation of northern lands would cut off the Arctic current, and have deflected the Gulf Stream, making the climate of England as warm as it is now. On the other hand there is no evidence of the submergence of the Isthmus of Panama, and if it had occurred the results would not have been comparable to the great extent of ancient glaciation. Moreover, if it is necessary that these two causes should co-operate, they would have to undergo synchronous changes for the production of the inter-Glacial and second Glacial periods—which is not likely to have happened. He admits, however, that depression will account for the raised beaches, but does not approve of the causes which have been assigned for such depression, except Dr. Drygalski's suggestion that the cold of the ice might have caused the underlying ground to contract; but if we were to suppose that the ice was the result of elevation, such a contraction would be quite inadequate to change an elevation into a depression [*see* No. 183, 1892].

***254. Reade, T. M.—High-level Shelly Sands and Gravels.**

Natural Science, vol. iii. pp. 423–435.

The author here does battle for the "submergence theory" as against that of the "Irish Sea glacier." First a summary of the facts to be explained is given. 1. The erratic blocks are mostly of foreign origin mixed with local ones. 2. Some are far-travelled and come from different directions, though mostly from the north. 3. They are above their level of origin. 4. They are partly rounded and some are striated. 5. The sands are composed of polished grains like those of marine sands. 6. They include shells like those on a beach. 7. The local blocks are more angular than the foreign ones. 8. The sands are current bedded. 9. In some cases there is Boulder-clay both above and below them. 10. They have the aspect of aqueous deposits. He then proceeds to discuss objections to the submergence theory.

I. Boulders, shingle, and gravel are found above the level of the rocks from which they are derived. *Answer:* (*a*) This is no easier to account for on the Glacier or Ice-sheet theory; and (*b*) the materials have been worked uphill in successive storm beaches as the land sank.

II. The high-level shelly drift is partial and sporadic. *Answer*: (*a*) The least quantity will always be deposited at the highest level, whether brought by land-ice or sea; (*b*) much erosion has taken place in the 6000 years since the close of the Glacial epoch.

III. The shells are always broken, as if a heavy body had rolled over them. *Answer*: (*a*) This is not always the case, *e.g.* in the Clava shell-beds at 503 ft.; (*b*) they are *beach* shells cast up from various depths, as on the Crosby shore [*see* No. **180**, 1892].

IV. The rocks in the drift are never found north of their origin. *Answer*: (*a*) Eskdale granite is found between Ravenglass and St. Bees, and Charnwood Forest rocks are found at Nottingham. (*b*) North-westerly winds were prevalent during the dispersion. (*c*) The wide distribution of Eskdale and Scotch granite, and of riebeckite rock from Macclesfield to Carnarvonshire, is a difficulty in the Glacial theory.

V. If the land had been submerged, deep-sea beds, containing shells in the position in which they lived and died, should be common, whereas there are none. *Answer*: It is quite probable that such deep-sea beds may not occur, or be quite exceptional in tidal seas; and some such may yet be found among the drifts.

VI. A subsidence of the land to the required depth is an improbability. *Answer*: Changes of level quite as great are known to have occurred in post-Tertiary times in America and Greenland.

He then turns briefly to the other, *i.e.* the Glacier theory. To this there are three main objections: (1) The causes appealed to are nowhere demonstrated in action. (2) The stones which are picked up from land on one side of the glacier being deposited on the other is not accounted for. (3) The physics of an ice-sheet have not been tested quantitatively.

***255. Reade, T. M.—Glacial Geology—Old and New: The New.**

Geol. Mag., Dec. 3, vol. x. pp. 35–37.

Draws attention again to the fact that the Lake District and Scotch rocks in the Drift are all mixed together from Moel Tryfaen to Macclesfield, and do not keep in separate trails as the author considers they ought to do on the hypothesis of an Irish Sea glacier. The account given of this supposed glacier and its branches, by Mr. P. J. Kendall [No. **179**, 1892], he calls "fairy tales of science indeed," for which he can find no evidence.

***256. Hull, E.—The Submergence of the British Isles during the Glacial Period.**

Geol. Mag., Dec. 3, vol. x. pp. 104–107.

The author first advances the old objections to the "Irish Sea glacier" theory, and then states that he has another objection to advance, "which is absolutely fatal to the transportation theory of Prof. Carvill Lewis and his followers." This objection is as follows: According to Ramsay the drifts in the heart of Wales, though not now containing shells, are marine in origin. There are also in Ireland shell-bearing drifts on the central plane, at various elevations, likewise considered to be marine. "If these had been formed by an ice-sheet, that ice-sheet must have moved *from the sea*," but instead of there being any evidence of this, the scratches and *roches moutonnées* show that the ice which caused them everywhere moved *from the land*.

***257. Hull, E.—The Great Submergence.**

The Glacialists' Magazine, vol. i. pp. 61-66.

The author regards the high-level gravels of the Thames valley and the quartz pebbles on the Cotteswolds as evidence of a submergence to at least 600 ft. As to the Irish Sea glacier, he repeats the objection of No. **256**. He accounts for the "absence of drift deposits on the eastern side of the Pennine Chain" by supposing that when the west side was submerged, the east side was blocked by Scandinavian ice. The submergence was unequal in different localities.

***258. Hardy, J. D.—Another View of the Submergence of the British Isles during the Glacial Epoch.**

Geol. Mag., Dec. 3, vol. x. pp. 277–279.

Argues from recent observations that the water was attracted by an ice-cap which the author supposes to have surrounded the Pole on all sides [*see* No. **183**, 1892].

***259. Shone, W.—Glacial Geology.**

Geol. Mag., Dec 3, vol. x. p. 93.

The exclusion of shell-bearing gravels from the heart of Wales is due to the land there having been covered by ice.

***260. Wallace, A. R.—The Ice Age and its Work.**

Fortnightly Review, vol. liv. pp. 616–633 and 750–774.

Part I. Erratic Blocks and Ice-Sheets.—The author first gives an account of the well-known phenomena in Europe and North America. The ancient Rhone Glacier is quoted as

showing that ice can travel over level country, up a hill, etc., and the only cause of motion must be "the slope of the upper surface of the glacier, the ice slowly flowing downward, and, by means of its tenacity and viscosity on a large scale, dragging its lower portion still more slowly over the uneven or upward sloping surface." He then describes the general phenomena of glaciation in Britain, as accepted by the ice-sheet theorists, and states their deductions therefrom.

Part II. The Erosion of Lake Basins.—As to the "origin of lake basins," the author considers that "the evidence in favour of glaciation has not yet been set forth in all its cumulative force." Plateau lakes are excepted from consideration. Passing in review the various mountain ranges of the world, it is shown that none, except the few which are known in other ways to have been glaciated, have any valley lakes. The absence of such lakes in some of the mountain districts, which have nevertheless been glaciated, may be explained by the absence of certain other essential conditions, or by the glaciation there not having been sufficiently powerful, since in the others the size of the lakes is proportional to the severity of the glaciation. The first essential for lake erosion is a differential action, caused locally, either by increased thickness of the ice, by a more open and level valley-floor, or by a more easily eroded rock. Glacial erosion is caused by the tremendous vertical pressure of the ice, which would have most power at its lower portion, where most stones have accumulated in it. The floor is lubricated by the melting ice, and probably "not more than half the entire bottom surface of the glacier would be in actual contact with the earth, so that even when a rock basin had been formed, the onward motion would be almost as great as ever." The Ice age is "to be measured certainly by tens, perhaps by hundreds of thousands of years."

In answer to objections he observes that the stones in a glacier moving against loose gravel or Boulder-clay would be pressed into it, and the moraine-stuff "would close up instantly behind it, under pressure of the ice, and thus leave no result." That glaciers have great erosive power is shown by the large quantity of mud which modern glaciers produce, and by the extent of the Drift derived from the Scandinavian ice-sheet, an amount estimated to produce an average depth of 500 ft. over all the glaciated area. He considers that no other theory of lake formation can seriously compete with glacial erosion, but that of unequal elevation transverse to pre-glacial valleys. As to this he asks: Why should convenient earth movements have always taken place round mountain regions that were subsequently to be glaciated, and not elsewhere? Moreover, he thinks that as earth-movements are slow and river erosion quick, the latter could have always kept pace

with the former. Again, the depth of the lakes is found to be proportional to the extent of glaciation of the district. Thus in Cumberland the lakes have a depth of 100–270 ft., in Scotland of 300–1000 ft., and in the Alps as much as 2500 ft. The deepest lakes also are found where a number of streams converge, and even these would only require a rate of erosion of one inch a year for 30,000 years. The lake bottoms also do not show the surface contours of river valleys, but there are often two or more basins in each, which may be considered to be at the particular spots of maximum local erosion. The tributary streams enter lakes referred to erosion at right angles, without any arm of the lake going up into the side valleys; hence "the lake *surface*, and not the lake *bottom*, represents approximately the level of the pre-glacial valley." The author finally discusses the particular case of Lake Geneva, which he believes to be of glacial origin.

261. Howorth, Sir H. H.—The True Horizon of the Mammoth: the foreign evidence and general conclusion.

Geol. Mag., Dec. 3, vol. x. pp. 20–27.

The author, having already considered the evidence as to Britain [*see* No. **190**, 1892], now turns to the continent and endeavours to show from the literature that "wherever the sequence has been actually ascertained . . . by one set of deposits being superimposed on the other . . . the beds with Quaternary mammals, in Switzerland, always underlie the erratic beds." He quotes the case of a mammoth skull below Boulder beds near Rapperschwyl, and other bones in a similar position at Neuchatel, as described by Escher-von-der-Linth. At Utznach, according to Heer, the lignite beds lie directly on the Miocene, and at Dürnten the stones below the lignite are all such as might be derived from the neighbouring conglomerates. At Wetzniken, near Dürnten, according to Mortillet and Grad, the Boulder bed is not satisfactorily shown to underlie the lignite, and the fossils, viz. *E. antiquus* and *E. leptorhinus*, are such as naturally occupy a low position. At Geneva, Favre can find no trace of two Glacial epochs. The lignite at Chambery, according to Mortillet, is pre-Glacial. At Drance, near Thonon, Mortillet has shown that the supposed lower Boulder beds have slipped down. On the south side of the Alps the lignites are shown by Gastaldi to lie directly on the Pliocene. The breccia at Hötting, above Innsbruck, contain plant remains supposed to be inter-Glacial, but Unger and Stur have shown that the flora includes fan palms, and is therefore of Tertiary age. In the basin of the Rhine, Falsan can find no evidence of two Glacial epochs. The evidence in North Germany is very contradictory and has been variously interpreted.

There is but scanty evidence in Scandinavia, but it tends to

indicate the earlier age of the fossiliferous deposits. In Russia Pander found stag's horns covered with clay containing northern erratics, and Sir R. I. Murchison records a similar fact near Moscow. In America the bones either occur outside the Drift area or are so scattered as to be probably remaniés. In Indiana only one forest bed is recognized, and this lies below the Drift. In Illinois the sand, with leaves and sticks, usually underlies the Drift, but in one place has 2–3 ft. of sand below it. The author does not state, as his conclusion from these facts, that the mammoth lived before the Glacial period, because he does not think the Drift to be the product of any such period, but to have been distributed by a diluvial movement of water.

***262. Hicks, H.—The Mammoth and the Glacial Drift.**

Geol. Mag., Dec. 3, vol. x. p. 90, and note on p. 139.

The author thinks the mammoth was pre-Glacial, and has, in fact, found a fragment of a tibia of *Elephas* below Boulder-clay, at Finchley. When the remains occur in overlying gravel, before we can accept their later date, we must have evidence that they have not been washed in as remaniés fossils.

***263. Stirrup, M.—The True Horizon of the Mammoth.**

Geol. Mag., Dec. 3, vol. x. pp. 107–111.

A reply to No. **261**. The author points out that the remains in the lignite beds of Dürnten and Utznach are of a mixed character, and include some recent species, so that they prove too much. Mr. Favre is quoted as saying that the "alluvions anciennes" in which the mammalian remains occur are *superposed* on Glacial beds, and "that the remains of *E. primigenius* come from post-Glacial beds," and that the author does not regard it as proved that the mammoth lived during the Glacial period. M. Falsan also records the mammoth from the post-Glacial lehm. In America, Prof. Shaler says the mammoth bones at Big Bone Lick are so well preserved as not to seem much more ancient than the buffalo bones which lie above them.

He then brings forward the positive statements of Tchernyshev that in the Tundras the sands with mammoth bones lie above the beds containing striated stones. The new Siberian expedition has shown that the carcases of mammoth there found in ice have fallen into crevasses in the ice from *superposed* argillaceous beds, and so have been preserved. He concludes that if the mammoth can be shown to be *also* pre-Glacial, it deserves the name of *Dicyclotherium* that St. Hilaire gave to it.

264. Howorth, Sir H. H.—The True Horizon of the Mammoth, etc.: being a reply to Mr. Mark Stirrup, F.G.S.

Geol. Mag., Dec. 3, vol. x. pp. 161–163.

The author accepts the recent species which occur in the lignite beds of Dürnten and Utznach as also pre-Glacial. He refers to the expedition to the *Bear Islands*, and sees no reason why the ice there found should be considered of Pleistocene age. As the mammoth bones are associated with leaves and land shells, the climate at the time of their deposit must have been warmer than when the ice was formed. He doubts whether the scratched stones of the Tundras are erratics, as they lie in a region beyond that of glacial striation. He demands an example of a *land-surface* with mammoth, overlying true drift in America, before he can accept the animal as post-Glacial there. He considers the lehm to be a flood deposit, and that the contents have been derived from a pre-existing land-surface. He quotes Tscherki as disbelieving in a Glacial period in Siberia, and as stating that the "well-known famous skeleton of a mammoth found at Troizkova, near Moscow," lay in a marine pre-Glacial bed. He also notes that by the "alluvion ancienne" Favre means a pre-Glacial deposit; it is only the "alluvion de terraces" which he says overlies the "terrain glacière," but the present author "believes there is no evidence of superposition."

***265. Stirrup, M.—The True Horizon of the Mammoth.**

Geol. Mag., Dec. 3, vol. x. pp. 334–336.

Quotes Heer as saying that the mammoth appeared in Switzerland at the end of the second Glacial epoch. As to Russia, the author was referring in No. **263** to the expedition to the Liakov Islands, and he notes that according to Baron Toll there are certainly traces of an Ice age in Siberia.

Sir H. H. Howorth replies again on pp. 353–355.

***266. Bulman, G. W.—The Effect of the Glacial Period on the Fauna and Flora of the British Isles.**

Natural Science, vol. iii. pp. 261–266.

The author argues against the supposed extermination during the Glacial period of the fauna and flora of the British Isles. On any of the current suppositions as to the extent of the ice there would still be left some ice-free ground where survival would be possible, and the proximity only of the ice would not prevent life in adjacent areas. The author considers the fossils found in the intercalated sands and gravels, and usually interpreted as inter-Glacial, to be evidences of such survival. The higher latitude to which glacial phenomena are restricted in Western Europe as compared with America, shows that the Gulf Stream was already in existence. The absence of certain animals in Britain after Glacial times shows that the country was not restocked from the Continent, but that part only of its previous fauna survived; the separation of Britain

being a pre-Glacial event. The distribution of certain plants confirms this view, for they would not be confined to the South of Ireland, Cornwall, and Norfolk respectively if they had travelled all the way from the continent since the Glacial period.

***267. Scharff, R. F.—The Pre-Glacial British Flora.**

Natural Science, vol. iii. p. 400.

Notes in confirmation of No. **266** that the Lusitanian flora of the South of Ireland is associated with the slug *Geomalcus maculosus*, which would be destroyed, and so would its eggs, by sea-water.

268. Howorth, Sir H. H. — The Condition of the Arctic Lands in the so-called Glacial Age.

Geol. Mag., Dec. 3, vol. x. pp. 302–309.

The author notes that, according to the accounts given of Iceland, the surface has never been polished, but the contours of the mountains are torn and splintered, and all around there are pinnacles in the sea. It is shown also by the history of the island that it formerly was wooded, though trees will not now grow there. The glaciers have also advanced during historic times. In Greenland there are several spots on the coast which once were good hunting grounds, but are now abandoned to the ice, and the glaciation of the rocks on the sea margin may be the work of shore-ice; the plants found on the Nunataks are thought to require the intervening ground to be free from ice for their dispersion. Spitzbergen is, as its name denotes, a land of needle-like rocks, and some of the best of the old harbours are now invaded by ice. The fauna and flora of all these localities must be the relics of former more extensive ones. These facts are considered to point strongly to the conclusion that the Glacial age did not extend to the Arctic lands.

269. Howell, F. W. W.—(The Glaciation of Iceland.)

Geol. Mag., Dec. 3, vol. x. pp. 426, 427.

States that there are signs of local glaciation in Iceland up to 1,000 ft., and in places up to 1,500 ft., but none above this level. There is none also on certain parts of the coast where even soft volcanic ashes have not been removed. The writer concludes that the island has never been completely covered with ice.

270. Howorth, Sir H. H.—The Recent Geological History of the Arctic Lands.

Geol. Mag., Dec. 3, vol. x. pp. 495–500.

Hooker considered the flora of Greenland to be of a Scandinavian type, which had been driven into the south corner of the land during Glacial times, and had since spread northwards again. Warming, however, divides the country into two botanical regions by a line drawn from 60° N. latitude on the east side to 62° N. on the west. The southern division contains several European plants, which, he thinks, have arrived there since Glacial times. The remainder of the flora are survivals through that epoch, during which the land was never entirely covered by ice. Other facts, showing the former more genial climate of the Arctic regions, lead the author to conclude that "if there has ever been a so-called Glacial period in the Arctic regions, it is now." This he considers to be the cause of the extinction of *Rhytina*, and of the habits of the northern migratory birds. This cold is caused by the well-known rise of land in those latitudes.

***271. Woodward, H.—The Recent Geological History of Arctic Lands.**

Geol. Mag., Dec. 3, vol. x. pp. 575, 576.

In reply to No. **270** the author remarks that it has not been shown when and how long in Tertiary times the warmer conditions of Arctic regions lasted. As to *Rhytina* it was kept alive by the warmth of the Gulf Stream, and its extermination was not the result of a change of climate but of the attacks of man.

***272. De Rance, C. E.—Presidential Address.**

The Glacialists' Magazine, vol. i. pp. 2–9.

Gives a brief summary of the non-glacial deposits of the Arctic regions, and of the present mode of action of the ice, with a view of showing that we cannot expect to recognize any old Glacial period there—the cold having increased only immediately before, or during the refrigeration further south.

273. Fielden, H. W.—Mild Arctic Climates.

The Glacialists' Magazine, vol. i. pp. 91-95.

Some trees found on the shores of Wellington Channel have been considered by A. R. Wallace and others to have grown there, and to indicate a mild climate. In a similar case, however, in Franz Joseph Land, the tree trunks were associated with marine shells, showing that they were really drift wood, and the same may be the case with the trunks in Wellington Channel.

274. Anon.—The Ice Age in North America.

Edinburgh Review, vol. clxxv. pp. 297–324 (1892).

The reviewer first mentions the known data, and then discusses the cause of the Glacial epoch. Using Niagara Falls as a gauge, he makes the date 6,000 years ago, and thinks the European ice to be "beyond all question of the same date as the American, because the same phenomena distinguish it." To this ice Palæolithic Man succumbed, or else was exterminated by post-Glacial floods, and left the globe to be repeopled by the Neolithic progenitors of the actual inhabitants. "A catastrophe is indicated, and a catastrophe by water. This is the conclusion of science, and how singularly it harmonises with the Biblical narrative it is almost superfluous to point out." The *cause* is considered to be as yet undiscovered.

CAVES AND FISSURES.

275. Jones, E.—Report of the Committee . . . appointed to complete the Investigation of the Cave at Elbolton, near Skipton, in order to ascertain whether Remains of Palæolithic Man occur in the Lower Cave Earth.

Rep. Brit. Assoc. for 1892, p. 266.

"No new features of any value have been obtained." "No indications of Palæolithic man have been found."

276. Peach, B. N.—On a Bone Cave in the Cambrian Limestone, in Assynt, Sutherlandshire.

Rep. Brit. Assoc. for 1892, pp. 720–721.

The author has examined the easternmost of the caves into which the streams above Inchnadampff fall, where they run underground for about a mile, At the top was a layer of peat, then a lenticular layer of calcareous marl with land shells. Below this was found red cave earth with charcoal and charred bones, indicating habitation by man. Below this is a layer of clay with quartzite boulders, then a layer with limestone fragments, and a canine tooth of the brown bear, and finally a layer of gravel composed of stones brought from a distance by the stream.

***277. Mansel-Pleydell, J. C.—A further note on the Dewlish "Elephant Bed."**

Proc. Dorset Nat. Hist. and Ant. F. C., vol. xiv. pp. 139–141, with 3 plates.

One of the plates is a view of the fissure, which resembles an open trench in a field, with mounds on either side; the second is a closer view, showing the bones lying *in situ* on the ground; the third gives views of a tusk and its alveolus. "The remains lay at depths varying from 3 ft. to 8 ft. below

the surface; beneath are lenticular beds of ferruginous loamy sand and two layers of thin flat flints, of which the lowest are the largest; both are unaccompanied by any sand or loam; large pieces of chalk, spheroidal flints, and some Palæozoic pebbles lay scattered throughout the bed." The author considers that the deposit may be assigned without much doubt to the Pliocene.

MIXED LOCAL.

***278. Lebour, G. A.—The Geology of Durham.**

Durham Gazetteer, pp. 77–86.

Gives a concise account of the rocks to be met with in the county, arranged chronologically.

279. Fairley, W. — Practical notes on the Geology of Wirral.

Trans. Fed. Inst. Mining Eng., vol. iv. pp. 321–327, pl. xvi.

The following synopsis of strata is given :—

		ft.
Post-Glacial	Peat and sand	25
Glacial	Upper Drift sand	10
	Upper Boulder-clay Middle Sands, 10 ft. Lower Boulder-clay Lower Drift sands	100
Keuper	Red Marl and waterstones	100
	Keuper Sandstone	170–200
Bunter	Upper soft sandstone	404
	Upper Pebble beds	415
	Lower Pebble beds	611
Permian	Lower soft sandstone	400
Carboniferous	Coal-measure	

Sections at six coal-pits are given. In one there are 17 ft. of coal in three seams, and 170 ft. of other strata; in a second 30 ft. of coal in 13 seams, and 556 ft. of strata; and in a third 19 ft. of coal in 10 seams, and 593 ft. of strata. In the remainder there is very little coal. The plate gives a map and horizontal section.

280. Ward, J. — The Progress of Geological and Palæontological Research in North Staffordshire, with a bibliography of works relating thereto.

Ann. Rep. and Trans. North Staffordshire Nat. F. C., vol. xxvii. pp. 67–107.

A historical sketch. The bibliography enumerates 125 names from 1679 to 1893.

281. Metcalfe, A. T.—Geology of Nottinghamshire.

In White's "Nottinghamshire," pp. 31.

This is an admirable summary of the present state of knowledge of the formations of the county by one who obviously knows the district well, and writes from personal knowledge. All the principal points about the Carboniferous, Permian, Triassic, Rhætic, and Liassic rocks are fully brought out, and the writings of all the best observers are quoted. The following points seem worthy of notice. He notes that the Magnesian Limestone in this county is not used for the manufacture of "Epsom Salts," though it is admirably adapted for the purpose. He considers that the Permian Marl lies unconformably on the Magnesian Limestone, and is itself overlapped unconformably by the Bunter, so that "there is unquestionably a very decided break between the Bunter and the Permian rocks below." On the origin of the Bunter pebbles he remarks: "It is true that it is not possible *lithologically* to distinguish the quartzites of the Pebble beds from the vast number of similar pebbles found in the Old Red Sandstone of Scotland. But there the resemblance ends. The pebbles of the Scotch area contain none of the fossils which occur in the quartzites of these Triassic Pebble beds. Lithological grounds are not in themselves sufficient ones on which to establish the identity of widely separated rocks." The following list of such fossils are quoted [?] as collected by W. Molyneux and named by Mr. Salter.

Pentamerus oblongus.
——— leus.
Atrypa hemispherica.
——— reticularis.
Spirifer cirspus.
——— trapezoidalis.
Strophomena depressa.
——— compressa.
——— pecten.
Orthis elegantula.
Pterinæa demissa.
Euomphalus sculptus.
Holopella obsoleta.
Palæocyclus præacutus.
Halysites catenulatus.
Petraia subduplicata.
——— crenulata.
Phacops Weaveri.
Tentaculites anglicus.

Poteriocrinus crassus.
Lithostrotion irregulare.
——— Martini.
Michelinia megastoma.
Syringopora reticulata.
Fenestella plebeia.
Productus semireticulatus.
——— concinnus.
——— mesolobus.
Streptorhynchus crenistria.
Spirifer triangularis.
——— bisulcatus.
——— octoplicatus.
——— glaber?
Chonetes variolata.
——— hardrensis.
Dentalium ingens.

The author favours Mr. Harrison's views as to their derivation from a concealed Palæozoic ridge, but does not quote the opinion of Prof. Bonney nor mention any of his papers in the

bibliography. It is also noted that at Ranskill, in the extreme north of the county, there is a deposit of nothing but small pebbles.

He believes that the Upper Mottled Sandstone is represented at Stapleford (quoting Dr. A. Irving) and also at Retford. The paper ends with a long bibliography.

282. Carr, J. W.—A contribution to the Geology and Natural History of Nottinghamshire.

Nottingham, Bell, 8vo, pp. 96. Price 2s. net.

The Geology occupies pp. 4–33, and contributions are acknowledged from **J. Shipman, R. M. Deeley,** and **J. M. Mello.** These provide a brief abstract of already published materials, the only novelty being J. Shipman's present repudiation of the Keuper age of the capping of Catstone Hill, after the Survey map has been altered to meet his view that it was Keuper.

***283. Browne, Montagu.—A contribution to the history of the Geology of the Borough of Leicester.**

Trans. Leicester Lit. and Phil. Soc., vol. iii. pp. 123–240, plates i.–v.

This memoir "brings together abstracts of the scattered papers of the various authors who have contributed to our knowledge of the geology of the district," with the author's remarks thereon. The various sections quoted, or boulders referred to, are numbered consecutively from 1 to 262. Nos. 1–5 of these deal with Upper Keuper marls, and the succeeding Nos. 6–105 with various parts of the borough. No. 6 is in a railway cutting of the Shoulder of Mutton Hill, and shows a good thickness of sandstone. No. 8, illustrated by a photograph, plate i., shows 17 ft. of sandstone at Dane Hill, one of the chief questions of interest being as to how far this sandstone is continuous beneath the borough, and the other sections quoted are said rather to support the negative. The greater number of these sections are very shallow ones, being merely road excavations, and are recorded here for the first time. The author thinks the sandstones found cannot be referred to any particular horizon. Much of the surface stuff that has been called "drift" is nothing but old rubbish or "filling." Plate v. is a longitudinal section, plotted from the data recorded in these sections. The next series, Nos. 106–165, illustrate the district on the opposite side of the Midland Railway, particularly Spinney Hill. Ten only of them have been previously published, mostly those which show the greater depths. The interest of these sections centres in their exposure of the Rhætic. Plate ii. illustrates three of these sections photographically, and another spot is mentioned where

the shales show glacial striæ. Nos. 166–196 illustrate the Knighton district, where the shallow excavations, maximum 14 ft. 7 in., show Drift lying on Lias or Rhætic; and Nos. 197–207 show Drift on Keuper.

Nos. 208–223 illustrate the Aylestone district, the principal interest of which is in the superficial deposits. Special attention is drawn to Beasley's sand-pit, which has already been three times described, but which the author considers to exhibit only one Boulder-clay instead of two, which should be classed with the "later Pennine," or Northern Drift. The "quartzose sand" below is full of coal fragments. Two plates, one plan, and one section are devoted to the Aylestone Road Gas Works, which show "the generality of the river drifts in the vicinity of Leicester."

Sections Nos. 224–229 are on the Midland Railway, the most important being that at the town end of the tunnel. Here 35 ft. of Boulder-clay is seen, which the author thinks has also been reconstructed in "later Pennine" times. The most remarkable feature in it is a large pocket of sand 75 ft. long by more than 42 ft. wide and 15 ft. in average thickness, entirely surrounded by Boulder-clay. In its false bedding, coal fragments, etc., this so closely resembles the "quartzose sand" of Beasley's pit that it "becomes a question whether the 'quartzose sand sea' has any foundation in fact." Here, also, there is but one Boulder-clay, though varying in appearance. At the base of the section come 3 ft. 6 in. of dark chocolate silt, without any stones.

Sections Nos. 230–234 are called the Wigton Road series. One is the boring described by J. D. Paul [No. **313**], the lower rocks of which the author thinks may possibly be Permian. Another is the Evington bore-hole for coal in 1877, of which the author gives a corrected reading.

The records of glacial erratic boulders are next summarized. All come from rocks within a distance of 10 to 12 miles, except one unverified group described by Mr. Plant in 1873. Finally a list of the fossils of the various rocks of the district is given—1, Keuper; 2, Rhætic; 3, Lias.

Echinostachys oblongus, 1.
Cidaris Edwardsii, 3.
Ophiolepis Damesii, 3.
Estheria minuta, 1.
Lima pectinoides, 3.
Pecten valoniensis, 2.
Avicula contorta, 2.
Modiola minima, 2.
Schizodus elongatus, 2.
——— depressus, 2.
Cardium Philippianum, 2.
Isodonta Ewaldi, 2.
Psiloceras planorbe, 3.
Schlotheimia angulata, 3.
Hybodus minor, 2.
Nemacanthus monilifer, 2.
Hybodus cloacinus, 2
Acrodus Keuperinus, 1.
——— minimus, 2.
Ceratodus latissimus, 2.
Gyrolepis Alberti, 2.
——— Quenstedti, 2 (new to Britain).
Colobodus maximus, 2 (new to Britain).
——— frequens (new to Britain).
Saurichthys acuminatus, 2.
Pholidophorus nitidus, 2.

To these are added lists of derived fossils in the Drift of Pleistocene mammalia, and of derived rocks and minerals in the boulders.

284. Cumming, L.—The Geology of Rugby.

Rep. Rugby School Nat. Hist. Soc. for 1892, pp. 4–8. Reprinted from Wait's "Rugby, Past and Present." Rugby, Frost, 1893.

The only rocks are Rhætic and Lias, dipping S.E. and overlain by Boulder-clay. From the Lower Lias of New Bilton were obtained in 1891 a nearly complete *Dapedius*, a new species of *Penæus*, and supposed parts of *Belemnite*. For the drift reference is made to papers by J. M. Wilson and T. B. Oldham.

285. Blake, J. F.—Excursion to Brill.

Proc. Geol. Assoc., vol. xiii. pp. 71–74.

In the Shotover sands at the top of Muswell Hill, a specimen of *Unio porrectus*—a Wealden species—was obtained; at the base of Brill Hill the Lower Portlandian was found very fossiliferous (10 species recorded); at Long Crendon, in one small quarry, near the mill, Gault, Shotover sands, Purbeck, and Portland were seen overlying in order; on the east side of the hill the Lower Portland is of a different character to that at Brill, being 20 ft. of pure yellow sand.

***286. Woodward, H. B.—Excursion to Norwich, the Bure Valley, Cromer, and Lowestoft.**

Proc. Geol. Assoc., vol. xiii. pp. 54–69.

The party visited Bramerton Pit, whence 19 fossils are recorded, and the adjoining Blake's Pit, where an antler of *Cervus Sedgwickii*, not previously known below the Forest bed, was found. A figure is given of the Thorpe Limepit, where the Norwich Chalk is now well exposed. At St. James' Pit, Norwich, the paramoudras were seen, and they are said to be only "gigantic flints, and gradations might be found between them and the ordinary flint nodules." On the shore at Trimingham thec halk floor is bent into a loop so as to overlie Boulder-clay, as seen in a photograph; and elsewhere also masses of chalk have been torn off and carried into the midst of the glacial deposits. The *Unio* bed at Sidestrand yielded many *Uniones*, now assigned to *U. tumidus* instead of *U. pictorum*. Near Runton a peculiar kind of schistosity or fluxion structure was pointed out in the contorted drift, which was considered due to a movement of the overlying mass, and a figure is given showing "eyes" of chalk.

286a. Whitaker, W., Skertchly, S. B. J., and Jukes-Browne, A. J.—The Geology of South-Western Norfolk and of Northern Cambridgeshire (explanation of sheet 65).

"Memoirs of the Geological Survey, England and Wales." London, Eyre and Spottiswoode, 8vo, pp. 178, price 3*s*.

The formations included in this memoir are the Jurassic, Cretaceous, and Glacial and Superficial. The method adopted is to bring together all that has been published, with additions from the materials collected by various geological surveyors, including, besides those mentioned in the title, Messrs. **A. C. G. Cameron, F. J. Bennett, C. E. Hawkins, C. Reid,** and **G. Barrow.**

The Jurassic rocks are the Oxford and Kimmeridge Clays, which are barely represented at Downham Market, a boring at Lynn, and at March and Southrey; 42 fossils from which localities are named. The Cretaceous rocks are represented by the Lower Greensand, the Gault, and the Chalk. The Lower Greensand is best represented at or near Downham Market, where it is divided into (1) a coprolite bed over a foot in thickness; (2) carstone, with phosphatic nodules, half a foot; and (3) red, white, and green sands, 20 ft. Fossils are recorded from West Dereham (22), Muzzle Hill (15), belonging to the Lower Gault; and from Grimston Brook (9), representing the Upper Gault, the peculiar species in which are *Ammonites lautus*, *Am. rostratus*, *Am. varicosus?* and *Inoceramus concentricus* var. The Chalk is divided into (1) Lower; (2) Middle and Upper, which two cannot here be clearly separated. Lower Chalk fossils are recorded from West Dereham (10), Stoke Ferry (7), and Shouldham (1); from the Chalk Marl—from Stoke Ferry (8), in the Totternhoe stone; and from Barton Bendish (9), Stoke Ferry (4), and Whillington (4), from the grey and white Chalk. *Holaster subglobosus* is recorded from all three subdivisions. The Middle and Upper Chalk are dealt with as showing the zone of *Rhynchonella Cuvieri*, which is the same as that of *Inoceramus labiatus*, and includes the Melbourne rock, the Chalk rock, and Chalk with flints, which belongs partly to the Middle and partly to the Upper Chalk.

The Glacial Drift comprises: 1. Beds below the Boulder-clay consisting of gravels and loams, with Palæolithic implements at Brandon, and illustrated by eight new sections showing great irregularity of the deposits. 2. Boulder-clay, illustrated by four new sections, some showing so much chalk as to be whiter than the chalk itself. 3. Beds above the Boulder-clay, consisting of irregular gravels. The post-Glacial Drift consists of: 1. Nar Valley brickearth, from which a list of fossils, compiled from published papers, is given, comprising *Elephas primigenius* and other mammals. 2. River gravel of the Ouse, Little Ouse,

Wissey Nar, and Gaytonthorpe. 3. Marine gravel of Ramsey and March, with a list of 46 fossils, of which eight are fresh-water. Numerous figures of Palæolithic implements are given, and it is noted that one has now been found in the marine gravel of March. The account of the peat and alluvium is for the most part taken from Mr. Skertchly's memoir on the Fenland, and a chapter on economic products concludes the memoir.

In Appendix I. are given details of two well sections in the district, one of which pierced 58 ft. of Kimmeridge Clay and 214 ft. of Oxford Clay; 20 from other parts of Cambridgeshire, seven from Norfolk, and three from Suffolk. Of these the following may be noted :—

Burwell.—Lower Chalk 48 ft. (max.), Gault.
Cambridge.—Gault 139 ft., Lower Greensand 15 ft.
Chesterton.—Gault 62 ft., Lower Greensand 22 ft.
Shelford.—Lower Chalk 120 ft.
Whittlesford. — Drift 62 ft., Chalk 87 ft. This shows the northerly continuation of the Drift channel described in No. **284**, 1890.
Wood Ditton.—Glacial Drift 75 ft., Upper Chalk 161 ft.
Downham Market. — Lower Greensand 27 ft., Kimmeridge Clay 187 ft.
Gaywood.—Lower Greensand 45 ft.
Narborough.—Chalk 85 ft., Gault 20 ft., Lower Greensand 48 ft.
Rougham.—Drift 100 ft.
Stoke Ferry.—Drift 25 ft., Lower Chalk 16 ft., Gault 16 ft., Lower Greensand, 17 ft.

Needham.—Glacial Drift 103 ft., Pebbly Gravel 34 ft., Norwich Crag 61 ft., Upper Chalk with flints 112 ft.
Norwich, Marlingford.—Drift 114 ft.
Norwich, East Carleton.—Drift 25 ft., Chalk 55 ft.

Ipswich, Stoke.—Gravel 20 ft., Chalk 223 ft.
Leiston.—Drift (?) 36 ft., Red Crag 134 ft., London Clay 48 ft., Oldaven Beds (?) 26 ft., Reading Beds 53 ft.

In Appendix II. eight groups of trial borings in Cambridgeshire and Norfolk are given, mostly penetrating only part of the surface deposits—the maximum depth of which is 43 ft.

***287. Holmes, T. V.—Notes on the Geology of the Neighbourhood of Chelmsford.**

Essex Naturalist, vol. vii. pp. 65, 66.

A few miscellaneous notes.

288. Topley, W.—Excursion to Amwell and Chadwell Springs.

Proc. Geol. Assoc., vol. xiii. pp. 123–125.

Gives the section of the bore-hole at Ware as showing:—

	ft.
Gravel	16
Chalk	542
Upper Greensand	77
Gault	160
Wenlock Shale..	36

Too great a thickness is here given to the Upper Greensand: the estimate probably includes the lower beds of the Chalk. The saturation of the Chalk in this district is seen by the water standing in the several wells up to 2 ft., 4 ft., 4 ft., 29 ft., 6 ft., and 16 ft. below the surface of the ground.

***289. Leighton, T.—Excursion to Abinger.**

Proc. Geol. Assoc., vol. xiii. pp. 163–167.

An account of the geology of Leith Hill is first given. The bulk of it is composed of Hythe beds, but the Bargate and Folkestone beds are brought in on the north by the comparatively high dip in that direction. A gravel at the junction of Raikes and Abinger Lane is shown by the absence of flints and the abundance of Bargate fragments to be of late date. The Bargate beds are here 40 ft. thick, the upper part being non-calcareous, pepper and salt, glauconitic, sand, which may be distinguished from the Hythe beds by the dirtier appearance and the absence of pockets of black, irony matter.

***290. Abbott, W. J. L. — Excursion to Basted and Ightham.**

Proc. Geol. Assoc., vol. xiii. pp. 157–162.

The author regards some of the deposits, called red-clay-with-flints, as of Crag age, similarly changed flints being found in the plateau deposits and in the Crag gravels. The gravels contain the deep-stained rough implements of plateau type. Five types of men have left their implements in this district: 5. The Neolithic. 4. Later Palæolithic of the rock shelters. 3. Valley men of the present river system. 2. Hill men before the existing features were commenced. 1. Old Plateau men.

***291. Monckton, H. W., and Mangles, H. A.—Excursion to Farnham.**

Proc. Geol. Assoc., vol. xiii. pp. 74–81.

Near Wrecclesham Church there is a section showing five beds of sand, etc., in the lowest of which were found phosphatic

nodules and *Am. Beudanti*, *Am. interruptus*, *Pecten orbicularis*, and *P. quinquocostatus*. In spite of these fossils the authors consider these sands more probably Folkestone sands, as a fragment of *Exogyra sinuata* was possibly found in one of the beds. At Crooksbury Hill a well was reported as passing through 175 ft. of Folkestone beds, and then reaching the Bargate stone.

292. Andrews, W. R.—The Origin and Mode of Formation of the Vale of Wardour.

Wiltshire Arch. and Nat. Hist. Mag., vol. xxvi. pp. 258–269.

In Purbeck times this vale was dry land, but the Cretaceous sea encroached on it, as we find the Wealden resting on Upper Purbeck at Dunton, and on Middle Purbeck further west. The Lower Greensand also extends over Wealden, Purbeck, and Portland in succession, and the higher beds behave in like manner. The crest of the anticlinal into which these rocks were afterwards thrown, lies nearer to the north than the south of the present valley. The first stage of surface sculpturing was the production of a plain of marine denudation in Pliocene times, when the slope of the drainage was easterly. The relics of this slope are seen in the diminishing heights, as we trace them to the east, of the summits of the downs, and in the patches of clay and flint and of old gravel. The valley opening westward was carved out of this plain at a later date.

293. Forsyth, D.—The General Geology of Scotland.

Trans. Leeds Geol. Assoc., part viii. pp. 34–47.

A general lecture on the subject, the newest information not being included.

294. Wallace, T.—Excursion to the Aird.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 115–125. (Read in 1885.)

The formations at the Aird are the Old Red Sandstone and the metamorphic series. There is amongst the latter a metamorphic limestone in which is found the mineral "abriachnite." The glaciation is from the south-west. Changes of level are also indicated by raised beaches. Lists of 48 minerals found in the North of Scotland and of the varieties of rock in the neighbourhood are appended.

295. Hinxman, L.—The Geology of the country between Huntley and Kildrummie Castle.

Trans. Inverness Sci. Soc., vol. iii. pp. 419–423. (Read in 1888.)

Various local details are given as to the distribution of Old Red Sandstone, knotted schist, andalusite and mica schists,

and contemporaneous diabase-porphyry; also of long winding ridges of sand and gravel due to post-Glacial floods in the valley of the Deveron.

296. Home, J.—The Geology of Nairnshire.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 51–57. (Read in 1884.)

Describes the "stratified crystalline rocks," the Lower and Upper Old Red Sandstone, and the Glacial and later deposits.

297. Stirling, Col., and Kidston, R.—Notes on the Flora of Stirlingshire and short Geological Sketch of the ground.

Trans. Stirling Nat. Hist. and Arch. Soc., 1892, pp. 74–102.

A general sketch of the geology in relation to the flora on the several rocks.

***298. Wilson, A. S.—Notes on the Geology of Fife.**

Trans. Geol. Soc. Glasgow, vol. ix. pp. 392–405.

A general account of the geology of the peninsula, which shows a northern zone of interbedded porphyrite, a middle zone of Old Red Sandstone, and a southern zone of Carboniferous strata, from the Calciferous Sandstone to the true Coal-measures. The Boulder-clay is 90 ft. thick in places, and in the west an old coast line can be traced a mile inland.

299. M'Lennan, J. S.—The Geology of Kyle.

Trans. Geol. Soc. Glasgow, vol. ix. pp. 264–266.

Kyle is the middle portion of Ayrshire. Miscellaneous details are given about the Silurian, Old Red Sandstone, Carboniferous (with lists of some of the coal-seams in various fields), and Permian rocks. The post-Carboniferous igneous rocks have hardened the pale-grey shales into the well-known "water-of-Ayr" whetstones at Stair. Boulder-clay, alluvium, raised beaches, and peat are also noticed.

300. Henderson, J.—On Sections Exposed on the line of the Barnton Railway.

Trans. Edinburgh Geol. Soc., vol. vi. pp. 297–300.

The first sections show drift with boulders arranged in a line, below which very few occur. The next shows Carboniferous sandstones dipping west at 30°, followed by whinstone, and then by black and grey shales dipping west at 20°, which become indurated and are then succeeded by the bulk of the greenstone. These shales the author considers to be "Wardie shales," and states that the igneous rocks cross the edges of the

sedimentary. He also mentions a thin vein of peculiar "trap" which separates into blocks and weathers into a brown-sand.

301. Tait, J.—Geology of the Eglingham District, with special regard to its Glacial Features.

Hist. Berwickshire Nat. Club, vol. xiii. pp. 220–224. (Read in 1890.)

The solid rocks are first noted; then it is said that the glacial striæ run mostly N. and S., but in some places N.W. and S.E.; and other miscellaneous observations are added.

***302. Sollas, W. J.—The Geology of Dublin and its Neighbourhood.**

Proc. Geol. Assoc., vol. xiii. pp. 90–122, plate iii.

The quartzites of the "Sugar-loaf" consist of rounded grains cemented by secondary silica, and are therefore of sedimentary origin; but under the great pressure to which the grains have been subject they have broken, and become rounded or bent. Occasionally the cement is ferrous carbonate. The Bray Head slates, though laminated and not cleaved, are too much altered to be called shales. The similarity of *Histioderma* and other worm tubes to those found at Assynt is regarded as suggesting a Cambrian age for these Howth and Bray rocks. *Oldhamia radiata*, being concave on the surface, may be "trailing marks of the anterior end of a worm," but *O. antiqua*, being convex, cannot be so explained. This period is spoken of as the age of worms. The lowest part is a "sherd-schist." Subsequent pressure has broken up the original quartzite beds, and carried pieces about like intratelluric erratics.

The Ordovician rocks are locally fossiliferous, as at Portraine and Rathdrum. They are usually associated with volcanic products, which is unfavourable to their being abyssal deposits. Some details of the volcanic rocks and their associated fossils are given, and Lambay Island is suggested as the centre of the volcanic activity; it lies in the line of such activity through Waterford and the Leinster granite. It is noted that this granite never comes in contact with the Cambrian, but is always flanked by Ordovician, and it is suggested that it may be a vast laccolite with Cambrian below. The granite consolidated by degrees, and had not ceased to move when the mica was formed from the magma. It is difficult to understand, if it were all fluid at once, how it could rise to so great a height without sending out more dykes than it does into the Ordovician. We need not, however, suppose it was thus all fluid at once, as contemporary dykes are found in it. The metamorphosing effect on the surrounding rocks is great, and the granite itself has become foliated and sheared into phacoids subsequently to its complete solidification. The mica schists produced by it out of the Ordovician

have been since invaded by an amphibolite dyke, which in the vale of Glendalough has destroyed the foliation and produced a "desmosite," which consists chiefly of garnets, with some quartz and biotite, while the dyke itself has become a quartz-mica-diorite. The rocks, after being elevated to form the Leinster Alps, were at last submerged in Carboniferous times, and the basal conglomerates with great granite pebbles indicate that there was at first an island reaching across to Wales, which the author calls "St. George's Island"; but during the Coal-measure period the whole was submerged, only to be uplifted again in the great mountain-building period which followed. One line of folding coincided with the older lines, but another ran east and west, and may be traced theoretically from the centre of Ireland to East Anglia. Very little change of level occurred here during Secondary and Tertiary times, even the courses of the present rivers being determined by the contour of the land left by the post-Carboniferous folding.

The glacial striæ are then noted: their direction and the source of the boulders indicate two ice-streams, one from the centre of the island and one from the Mourne Mountains on the north. The suggestion of Mr. Maxwell Close that much of the Middle Drift with its shells may have been derived from the Boulder-clay, which also contains shell fragments, is adopted; but with regard to the supposed lifting of shell-beds from the sea-bottom, it is stated that many of these shelly drifts lie in the course of glacier ice, which, so far as can be determined, never passed over any sea-floor, but flowed wholly on the land; and the explanation of this by a pre-Glacial depression is not considered a very probable one. The eskers were certainly formed before the close of the Glacial period, as there are erratics lying on them, and they were undoubtedly formed by rapidly moving water, so that their explanation by glacial streams meets with fewest objections. Subsequent changes of level are indicated by submerged peat forests and raised beaches.

***303. Cole, G. A. J.—Excursion to the counties of Dublin and Wicklow.**

Proc. Geol. Assoc., vol. xiii. pp. 168–177.

This report consists mostly of local details, confirming the statements in No. **302**. At the Needles, Howth, some dark tubular bodies were found in the sandstone and were attributed to worms. At Three Rock Mountain, Mr. Maxwell Close and the author agreed that the shell-beds had not been pushed up by ice, but were the result of a submergence, and in the author's opinion had been rearranged by river-action.

304. Kinahan, G. H.—The Scalp, county Dublin.

The Irish Naturalist, vol. ii. pp. 241–245.

Thinks the Scalp and similar valleys to be "nearly solely due to simple shrinkage fissures," "formed after the ice-cap had disappeared," "and not subjected since its formation to the effects of any denudants."

305. Wardingley, C. L.—The Rocks of the North-West of Ireland.

Science Gossip, 1893, pp. 169–171.

Short notes on a large subject.

***306. Collenette, A. — First Annual Report of the Geological Section.**

Rep. and Trans., 1891, Guernsey Soc. Nat. Sci. and Local Research, pp. 119–128.

A local deposit consisting of white and yellow clay, with loam to depth of 19½ ft., has been met with in a well, and there are other clay deposits at Vrangue, Delancey Hill, and Grande Mare. Raised beaches are recorded at 14 localities, and mica-trap at Fort la Crocq, Hommet, Grandes Rocques, Port Sorf, and Albreq.

***307. Collenette, A.—Report of the Geological Section.**

Rep. and Trans., 1892, Guernsey Soc. Nat. Sci. and Local Research, pp. 181–187.

Notes are given of a 30 ft. deposit of clay at Vale, also at Mare de Carteret and eight other places, raised beaches at eleven, and rubble head at eight. Also mica-trap at Putrin, St. Martin's Point, and Long Port, Vazon.

WELL SECTIONS AND BORINGS.

***308. De Rance, C. E. — Eighteenth Report of the Committee . . . appointed for the purpose of Investigating the Circulation of Underground Waters in the Permeable Formations of England and Wales, and the Quantity and Character of the Waters supplied to various Towns and Districts from these Formations.**

Rep. Brit. Assoc. for 1892, pp. 264–266.

No information is contained in this report. The series is to come to an end, and a summary of the first seventeen reports is to be prepared.

309. Coulson, F. — Section of Strata sunk through in No. 2 Shaft, Deaf Hill Colliery, co. Durham, for the Tremdon Coal Co., during the years 1891–2, with notes on the Fossil Fish of the Marl Slates therefrom, by Dr. R. H. Traquair, F.R.S.

Trans. Manchester Geol. Soc., vol. xxii. pp. 191–195.

The full details of 87 subdivisions are given in the paper, which may be summarized as follows:—

	ft.	in.
Superficial deposits	54	0
Permian ? Marls	88	2
Magnesian Limestone	197	2
Marl Slate	4	5
Lower Red Sandstone	7	5
Coal-measures	125	11
Coal	3	7
Measures	67	8
Main Coal	4	2
Measures	126	7
Low Main Coal	3	6
Measures with their Coals	114	11
Hutton Seam	2	5
Measures with their Coals	132	1
Harvey Seam	3	1

The fishes of the marl slate belong to *Palæoniscus Friesleboni*, *Pygopterus Humboldtii*, *Dorypterus Hoffmanni* (the fifth known), and *Acentrophorus glaphyrus*.

310. Chambers, W. H.—The Pumping Appliances used in the Sinking Operations at the Cadeby New Winnings.

Proc. Midland Inst. Min. Mech. and Civ. Eng., vol. xiii. pp. 43–48, plate xxxiii.

The plate gives detailed sections of the rocks passed through in the sinkings. Cadeby is just on the edge of the Magnesian Limestone, opposite Conisborough Station.

No. 1 Pit.	ft.	in.	*No. 2 Pit.*	ft.	in.
Drift	32	0	Drift	36	5
Measures	25	4	Measures	19	4
Coal	2	6	Coal	2	0
Measures	16	6	Measures	29	2
Coal	1	0	Coal	0	8
Measures	28	3	Measure with ironstone ..	114	8
Coal	1	6	Three Coals	3	7
Measure with ironstone and fossils	116	11	Measures	31	10
Coal	2	0	Coal	0	3
Measures	36	5	Measures	139	1
Coal	0	6	Coal	0	6
Measures	135	0	Measures	60	2
Thin Coals	4	8			
Measures	68	0			
Coal	2	0			
Measures	14	5			

***311. De Rance, C. E.—Results of the Salt Union Boring at Marston, near Northwich.**

Trans. Manchester Geol. Soc., vol. xxii. pp. 269–291.

The author, relying upon the indications known on the surface, had thought it probable that Coal-measures would be found at a depth of 3000 ft. in this locality, and had therefore approved the sinking of a trial bore-hole to that depth. The Keuper marls, however, have turned out to be of exceptional thickness and to include a thick band of Upper Keuper Sandstone, unknown on the surface in Cheshire or Lancashire. Thus the area was one of special local depression in Keuper times, and this led to the formation of the rock salt. It is not now probable that any Coal-measures will occur at a less depth than 3800 ft.

The full journal of the borers shows 270 different strata, enumerated in the paper, but of which the author gives the following summary:—

		ft.	in.
Glacial	Glacial drift	31	9
Keuper Marls	Marls with rock salt	382	5
	——— gypsum	664	8
	Sandy marls	214	11
	Upper Keuper Sandstone	175	7
	Sandy marls	326	4
Lower Keuper Sandstones	Waterstones	226	4
	Frodsham beds	168	3
	Basement beds	313	10
Bunter	Upper Mottled Sandstone	106	2
		2610	4

***312. Hull, E.—On the discovery of a Concealed Ridge of pre-Carboniferous Rocks under the Trias at Netherseal, Leicestershire.**

Geol. Mag., Dec. 3, vol. x. pp. 552, 553. (Read at B. A.)

A boring has been put down at Netherseal Colliery, and the author, from an examination of the cores, considers the beds passed through to have been as follows:—

		ft.	in.
Trias	Bunter Sandstone—light reddish-brown pebbly sandstone	262	0
Coal-measures	Grey and black shales and sandstones, with coal and ironstone; plants abundant ...	514	0
Pre-Carboniferous	Reddish, purple, and grey grit, sandstone, and micaceous quartzite	19	0

The last-named do not resemble the rocks of Hartshill very closely, but still more closely than any others; and in another boring near the same spot the resemblance is closer, so that they are probably Cambrian.

***313. Paul, J. D.—Boring at the Knighton[1] Co-operative Shoe Works.**

Trans. Leicester Phil. Soc., vol. iii. pp. 105, 106.

[1] For Knighton, etc., read, "Wheatsheaf C. S. W. at Knighton."

This boring commenced close to the outcrop of the Rhætic and passed through 622 ft. of red Trias marls, sandstone, and gypsum, till it reached a conglomerate band. This, then, is the thickness of the Trias [Keuper and Rhætic ?] at this spot, which is the same as that previously met with at Evington. Below this was 63 ft. of blue and black Carboniferous shale, followed by 15 ft. of pyritous crystalline limestone, which, on analysis, is found to be magnesian. The author correlates all the Carboniferous material with the "dolomitic magnesian limestone of the Lower Carboniferous series," *i.e.* with the beds at Gracedieu and Bredon, and argues thence that Charnwood must have been an island in the Carboniferous sea with shore deposits on the north and south.

***314. Jukes-Browne, A. J.—A Boring at Willoughby in Lincolnshire.**

Geol. Mag., Dec. 3, vol. x. p. 142.

States that he will publish No. **315** shortly.

***315. Jukes-Browne, A. J.—On some recent Borings through the Lower Cretaceous Strata in East Lincolnshire.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 467–477.

The first boring is at Willoughby, and passed through—

	ft.
Glacial deposits	63
"Roach" beds	43
Tealby clay	108
Ironstone beds	11
Spilsby sandstone	13

The last yielded abundant water, which rose 30 ft. above the surface of the ground.

The second boring is at Alford, three and a half miles to the north, and passed through—

	ft.
Glacial deposits	69
Lower Cretaceous beds ..	43

Amongst the glacial deposits is included a mass of chalk 10 ft. thick, but this, as it had gravel beneath it, is taken to be a boulder, like those at Cromer. The first 11 ft. of the Lower Cretaceous is also worked up with the Boulder-clay. Good results were not obtained from the lower beds, but the chalk boulders were found to yield a satisfactory supply. A similar mass of chalk 26½ ft. thick has also been found previously at Alford at a depth of 38½ ft.

The third boring is at Skegness, 7½ miles S.E. of Willoughby It passed through—

	ft.	in.
Marsh beds	34	0
Glacial deposits	26	6
Rock chalk	21	0
Red marl	20	0
Carstone	10	0
Roach	28	6
Clays	189	0
Oolitic ironstone beds ..	13	6
Clays?	18	6
Spilsby sandstone	26	0
Kimmeridge clay	78	0

The clays and ironstones are thicker here than at Willoughby. The rocks found in these borings show that "the subterranean outcrop of the Lower Cretaceous strata extend northwards for a much greater distance on the eastern side of the Wolds than was previously supposed." As, however, further east the chalk immediately underlies the superficial deposits, this outcrop can only be a tongue, which is thought to be connected at its northern end with the main mass of the Wolds by a transverse anticlinal in the Calceby Valley, in which case the chalk between Calceby and Claxby is an outlier.

316. Martin, E. A. — On the Underground Geology of London, No. ii.

Science Gossip, 1893, pp. 11–15.

From the data obtained in the various borings between Burford and Dover, a general section along the line joining these is constructed, also another from Burford to Harwich. There is inserted in both a central anticlinal below the Cretaceous strata, and Lias is marked as found in the Dover boring [*cf.* Introductory Review, 1892].

317. Anon. (R. M. W.)—Scientific Memoranda.

Rep. and Trans. Devonshire Assoc., vol. xxv. p. 173.

A well put down in Plymouth remained in limestone all the way to a depth of 470 ft. No good water was obtained, though in a neighbouring well a water-bearing fissure was struck.

***318. Lucy, W. C.—Section of Coal-field near Newent. Shaft B.**

Presidential Add. Proc. Cotteswold Nat. F. C., vol. xi. pp. 14–17.

The following section [here abridged] is given in a tabular form:—

	ft.	in.
Raised ground	4	0
Soil and sand	8	0
Sandstone	15	0
Clod	6	0
Sandstone	9	0
Clod and conglomerate	12	0
Sandstone	12	0
Red sandstone and marl	36	10
Dark pebbly ground	5	0
Sandstone and conglomerate	10	6
Red marl	3	6
Red sandstone	22	6
Conglomerate	4	8
Pebbly sandstone	22	0
Conglomerate	36	0
Sandstones	53	0
Red and rocky marls	54	1
Brown binds	17	0
Unconformity.		
Grey and blue binds	26	3

***319. Winwood, H. H.—On some deep Well-borings in Somerset and elsewhere.**

Proc. Bath Nat. Hist. and Ant. F. C., vol. vii. pp. 335–340.

Details of the following sections are given:—

South Slope of Lansdown, Bath—

	ft.	in.
Brash	3	0
Midford sands	15	0
Oolitic limestone, highly fossiliferous ..	3	0
Light blue clay with *A. communis* and *A. bifrons*	13	0

At Monkswood five trial holes are noted—

	1 ft.	1A ft.	2 ft.	3 ft.	4 ft.
Height above sea-level	369	364	365	325	—
Peat, etc.	—	—	—	—	19
Midford sands	20	8	18	7	—
Clay, yellow or blue ..	3	3	—	4	26
Sand burrs	—	—	9	—	—
Cephalopod conglomerate ..	—	—	5	—	—

319a. Whitaker, W., and Woodward, H. B.—Notes on some Somerset Wells.

Proc. Bath Nat. Hist. and Ant. F. C., vol. vii. pp. 340–345.

The following are given in detail:—

Bedminster. — Drift and Sand 46 ft., Trias 25½ ft., Coal-measures (?) 29 ft.
Curry Rivell.—Lias Clay and Rock 310 ft.
Harptree.—Trias 247 ft., Coal-measures 348 ft.
Langport.—Made Ground 9 ft., Alluvium 43 ft., Keuper with Gypsum 206 ft.
Shepton Mallet.—Lias 98½ ft.
South Widcombe.—Red Marl 183 ft., Dolomitic Conglomerate 28 ft.
Taunton.—Trias Marls 194 ft.
Taunton.—Made Ground and Gravel 8 ft., Trias Marls with Gypsum 287 ft.
Wrington.—Drift and Gravel 9 ft., Trias 85 ft., Limestone 6 ft.

MISCELLANEOUS.

***320. Hudleston, W. H. — On some Recent Work of the Geological Society.**

Proc. Geol. Soc., vol. xlix. pp. 65–142. Presidential Address.

In this address the works of the authors who have read papers before the Geological Society of London during the last seven years, and in some cases other publications, are reviewed. In this first part only those works are considered which deal with post-Palæozoic strata. In the most part the reviewer contents himself with expounding his author, and pointing out the bearings of the work, but in the following cases he expresses opinions of his own.

It is pointed out that the great thickness denuded from the gorge at Goring, according to Prof. Prestwich, since the commencement of the Glacial period is scarcely in accordance with the moderate limits which, in another place, the author assigns to the entire Glacial period. With regard to the two schools of Glacial Geology, the author has an obvious inclination towards the "new." Thus he points out that parallel ice-scratches cannot be expected from floating ice, also if there were no submergence the difficulty of the Cae Gwyn cave deposits would be at an end. "It is the dynamical question which has been the chief obstacle to the general acceptance of this [great glacier] view; if that part of the problem could be satisfactorily solved, we should accept with thankfulness an explanation which does away with the necessity for belief in the great submergence and all the incongruities which that belief involves." He does not see much chronological value in the tripartite division of the glacial deposits of East Yorkshire, the divisions representing merely the physical history of one great glacial movement.

It is considered a weak point in the argument for the existence of oceanic deposits that the radiolarian marls and red earths of Barbadoes are thought to require a very deep sea, since by a comparison of the deposits at different stations recorded by the "Challenger," it is clear that their nature depends on other things than depth, and a radiolarian earth was obtained by the "Cyclops" from a depth of not more than 2,200 fathoms.

The Red Chalk and the Norfolk Gault are proved by their fossils to be mainly on the same horizon. The former is not thought to be of deep-water origin as a whole, but to have been formed where powerful currents limited the amount of sediment thrown down.

As to the base of the Inferior Oolite, Mr. S. S. Buckman has at length succeeded in proving that all the "sands" are not on the same horizon. Though Ammonite zones have a chronological value, the proposal to take the reign of the *Hildoceratidæ*, as indicating a distinct series, to be called Toarcian, will not work at all throughout the greater part of England. The author is inclined to draw the boundary between Lias and Oolite at the base of the *Opalinus* beds, and hence the Gloucestershire sands, which lie below the so-called Cephalopoda bed, can scarcely be classed with the Inferior Oolite without some qualification.

***321. Holmes, T. V.—Excursion to the Deneholes of Hangman's Wood, near Gray's Thurrock, Essex.**

Proc. Geol. Assoc., vol. xiii. pp. 178–182.

The interest of this is almost entirely antiquarian.

PALÆONTOLOGY.

GENERAL.

322. Woods, H.—Elementary Palæontology for Geological Students.

Cambridge, Univ. Press, 8vo, pp. 222.

By "Palæontology" is here meant that branch which deals with invertebrate animals. In the introduction the methods of preservation are discussed, particular attention being given to the difference between arragonitic and calcitic material as to the power of resisting changes. The general method adopted in the body of the book is to give a brief description

of the various classes arranged under eight sub-kingdoms, with a short outline of their subdivisions, and then to add definitions of certain selected genera with their range in time.

***323. Williamson, W. C. — On the Mineralization of the Minute Tissues of Animals and Plants.**

Journ. Quekett Micr. Club, ser. ii. vol. v. pp. 186–195.

Deals with the methods of fossilization of organic remains by the infiltration of carbonate of lime, silica, pyrites, etc.

324. Anon.—Chemistry and Palæontology.

Internat. Journ. Micr. and Nat. Sci., vol. iii. p. 21.

Quotes from the "Comptes Rendus" that the proportion of fluorine in fossil bones increases with the geological age, and gives an example in which this test determined whether a certain tibia was fossil or not.

***325. Woodward, A. S.—Third Report of the Committee . . . to consider the best methods for the Registration of the Type Specimens of British Fossils.**

Rep. Brit. Assoc. for 1892, p. 289.

During 1891–2 the committee have received catalogues of the type fossils in 19 museums and 13 private collections, but they do not publish them.

***326. Bolton, H.—Catalogue of the Types and Figured Specimens in the Geological Department [of the Manchester Museum].**

Manchester, Cornish, 8vo, pp. 39, 1 plate.

This is more than a mere catalogue; notes on the character of the specimens and synonyms of the names, and figures of several, being given. Two species are called new, but their descriptions have now been published in the Geol. Mag. [*see* Nos. **367**, **401**]. The list includes 5 Plants, 1 Foraminifer, 2 Echinoderms, 6 Pelecypods, 3 Gasteropods, 15 Cephalopods (Brown's), 16 Crustaceans (Jones and Kirby, and Hicks), 4 Eurypterids, and 6 Fishes — which are types; also 4 Plants, 4 Brachiopods, 1 Crinoid, 2 Pelecypods, 4 Cephalopods, 2 Crustaceans, 1 Fish, and 2 Mammals — which are figured specimens.

The following are figured:—

Calamites Suckovii.
Stigmaria ficoides.
Pygocephalus Cooperi.
Cyclus Scotti.
Pterygotus ludensis.
Diplopterus Agassizii.
Myriolepis hibernica.
Machærodus latidens.
Elephas primigenius.

327. Traquair, R. H.—List of the Type and Figured Specimens in the "Powrie Collection" of Fossils.

Ann. Scottish Nat. Hist., vol. i. pp. 31–39 (1892).

This collection is now in the Edinburgh Museum of Science and Art. The list includes 7 Merostomates, 1 Myriapod, 19 Fishes, and 1 Reptile—which are types; and 6 (all one species) Merostomates, 1 Myriapod, 11 Fishes, and 1 Reptile—which are figured specimens. Under the head of *Dendrodus incurvus* it is noted that the name *Cricodus*, Ag., which that author identified with this *Dendrodus*, was founded on an indeterminate tooth, and must therefore drop.

***328. Woods, H.—Additions to the Type Fossils in the Woodwardian Museum.**

Geol. Mag., Dec. 3, vol. x. pp. 111–118.

The following additional collections are noted: Binney, Carter, and Tawney. The additional types, either new or not before noted, include 8 Plants, 2 Crinoids, 3 Brachiopods, 28 Pelecypods, 25 Gasteropods, 1 Chiton, 5 Cephalopods, 1 Trilobite, 17 Phyllocarids, 12 Decapods, and 7 Fishes.

329. Woods, H.—Woodwardian Museum, Cambridge: Catalogue of the Fossils in the Students' Stratigraphical Series.

Cambridge, Univ. Press, 8vo, p. 23.

This is a collection of typical fossils arranged according to the minuter subdivisions of the series, and the class or order of each is indicated. Including plants and vertebrates, 182 are selected from the Palæozoic, 290 from the Mesozoic, and 186 from the Cainozoic.

330. Newton, R. B.—Catalogue of Fossils presented to the Board [School Board of London] by the Trustees of the British Museum.

London, Alexander and Shepherd, 8vo, pp. 36.

***331. Collins, J. H.—A Working List of the Palæozoic Fossils of Cornwall.**

Trans. Roy. Geol. Soc. Cornwall, pp. 61 (reprint).

An outline history of the various discoveries is first given, and then a list of all the recorded species, with synonyms, compiled from all accessible sources. It includes 20 Corals, 6 Polyzoans, 9 various, 76 Brachiopods, 22 Pelecypods, 16 Gasteropods, 2 Pteropods, 4 Heteropods, 31 Cephalopods, 16 Echinoderms, 15 Trilobites, 1 Entomostracan, 10 Fishes, and 4 Plants.

Amongst these are recorded two new species, to which, however, no names are assigned, viz. :—

Leptæna, "n. sp."—"Displays five strongly marked ridges, extending across the shell, in line with the hinge-joint."

Orthis, "n. sp."—Davidson, Sil. Brach., V. Pl. xlii., fig. 13.

***332. Hind, W.—Additions to the Palæontology of North Staffordshire.**

Ann. Rep. and Proc. North Staffordshire Nat. F. C., vol. xxvii. pp. 108–115, with 4 plates.

Notices his work on the Anthracopteran shells, read to the Geological Society of London [*see* No. **379**], and records *Streptorhynchus crenistria* from the deep pit at Hanley. and eight fossils from the Upper Yoredales of Congleton Edge, not recorded in the Survey Memoir. Also *Dithyocaris testudineus*, from the Yoredales, for the first time. The plates are reproductions of those of No. **379**.

HUMAN IMPLEMENTS.

333. Laing, Sam.—The Antiquity of Man.

Separately printed in connection with the Brighton and Sussex Nat. Hist. Soc., in 1891, pp. 19, 8vo.

The author accepts Man as pre-Glacial and even as Tertiary.

***334. Woodward, H.—Early Man in Britain and the Animals he Saw and Hunted.**

Rep. and Proc. Ealing Micr. and Nat. Hist. Soc. for 1892.

Abstract of a lecture.

***335. Mello, J. M.—Primitive Man. II. Neolithic Man.**

Advance copy to be printed in Trans. Victoria Institute.

A general summary of the known facts about him.

336. Neilson, J. — On the Modern Manufacture of Ancient (?) Flint Implements, including an Interview with an Irish "Flint-jack."

Trans. Geol. Soc. Glasgow, vol. xx. pp. 367–372.

This flint-jack affects the neighbourhood of the Giant's Causeway, where he deludes the incautious collector.

***337. Dawkins, W. B.—On the Relation of the Palæolithic to the Neolithic Period.**

Journ. Anthrop. Inst., vol. xxiii.

This paper is intended as a reply to one by Mr. J. A. Brown [No. **239**, 1892] on the continuity of the Palæolithic and Neolithic periods. The author wishes to show that these two periods do *not* shade into each other—because when their respective mammalia are considered they show very great differences, and in particular there are no domestic animals associated with Palæolithic man. In the Palæolithic period England was part of the Continent, and in the Neolithic it was insular. The supposed transition forms found on the South Downs are of unknown age, and those found in the mines are wasters.

338. Bell, A. M.—Remarks on the Flint-Implements from the Chalk Plateau of Kent.

Journ. Anthrop. Inst., vol. xxiii. pp. 266–281, plates xiv.–xvi.

The plateau flints are ochreous-stained, therefore they belong to the age of the gravel in which they are found. They are rolled, and therefore they are not refuse flakes. The arguments of W. B. Dawkins against this conclusion are then discussed. As to the flints themselves, the author had been always instructed that we could not believe in any implement unless it showed a bulb of percussion; but a number of what he cannot doubt to be implements are here figured which closely resemble accepted ones in all points except the presence of such a bulb. Moreover, there are passages from the plateau type to the Palæolithic, some showing the graceful curves and thin flakes split off, as in the latter.

339. Bell, A. M.—Exhibition of Pre-Palæolithic Flints.

Rep. Brit. Assoc. for 1892, p. 900.

These are the plateau implements of North Kent [*see* No. **338** and Nos. **291, 292**; 1892]. The author argues for their being true implements.

340. Church, G.—Note on the Discovery of some River-Drift Implements at West Wickham, Kent.

Science Gossip, 1893, pp. 135, 136, and pp. 176–178.

The implements consist of 20 hatchets, 34 scrapers, 50 flakes, and 20 miscellaneous. A scraper and two flakes are figured.

341. Smith, F.—Discovery of the Common Occurrence of Palæolithic Weapons in Scotland.

Rep. Brit. Assoc. for 1892, pp. 896, 897.

The author states that he has found in the neighbourhood of Perth, and along the rivers of that locality, at least 350 specimens which he believes to indicate a long-continued

sojourn of Palæolithic man north of the border. Also that certain characteristic portions of the Boulder-clay yield abundant evidence of the same in the shape of glaciated, broken, and crushed specimens of his weapons.

***342. Smith, J.—The Ardrossan Shell-Mound, with an account of its Excavation.**

Trans. Geol. Soc. Glasgow, vol. ix. pp. 355–366, plate xi.

The shell-mound in question lies close to Ardrossan Station, the whole length of its north-east side lying against and under the rocky side of Cannon Hill. It is 102 ft. long by 16 ft. broad, and rests on a raised beach only separated from it by half an inch of soil; and there is no rock talus below, but plenty above, from which it is argued that the men came to the spot soon after the water had left it. There are a great many specimens of *Trochus linearis*, which is now extinct on the west coast of Scotland. The men also fed largely on limpets, but preferred land animals to fish. A human jawbone or two thrown aside with the other refuse is taken to indicate that they were occasionally cannibal. Fire-relics occur, but the bones are not charred. Amongst other relics are a sandstone anchor seven inches long, a perforated sinker, and pieces of gas-coal probably used as charms. Overlying this shell-mound are other deposits, with pottery and bronze of a later date. As there are no flints, the author concludes that the shell-mound was formed anteriorly to their use. In one section, however, hammer stones occur. The animals whose remains are noted comprise 18 mammals, 6 birds, 2 fish, and 16 molluscs. Amongst the mammals are a beaver and great numbers of a large dog or wolf.

343. Peach, B. N., and Horne, J.—Notes on a Shell-Mound at Tongue Ferry, Sutherlandshire.

Trans. Edinburgh Geol. Soc., vol. vi. pp. 303–308.

On the western shore of the Kyle of Tongue, about 70 yards north of the Ferryhouse, a shell-mound occurs on the 25 ft. raised beach. The shells are the ordinary ones, the most abundant being the oyster, which is not now found in the Kyle. With these shells was found a broken celt of dolerite with a cutting edge, possibly Neolithic.

MAMMALIA.

344. Zittel, K. A. — The Geological Development, Descent, and Distribution of the Mammalia.

Geol. Mag., Dec. 3, vol. x. pp. 401, 402, 455–468, and 501–514. Translated from the last chapter of vol. iv. of the "Handbuch der Palaontologie."

The genera of mammals obtained from various formations in all parts of the world are here enumerated, and miscellaneous observations made about them and their connection with each other. It is concluded that "from the Tertiary period onwards the distribution of the land mammalia went forth from certainly not more than three areas of development or so-called 'centres of creation.'" These are the Australian, which was at one time connected with South America; the South American, from which some wanderers arrived in Africa, and which towards the close of the Tertiary period overlapped North America; and the Arctogæan, from which the faunas of Europe, Asia, Africa, and North America have descended. The most differentiated have been earliest separated.

***345. Howard, F. T.—A Note on Early Fossil Mammalia.**

Rep. and Trans. Cardiff Nat. Soc., vol. xxiv. p. 12.

An exhibition of casts of the Stonesfield mammal jaws.

346. Morris, D. B.—Mammalian Remains found in Peat Moss at Dunblane.

Trans. 1893 Stirling Nat. Hist. and Arch. Soc., pp. 104–106.

The relics all belong to the red deer.

347. Clark, J. E.—The Earliest Mammals.

The Nat. Hist. Journ., vol. xvii. pp. 38–40, with a plate.

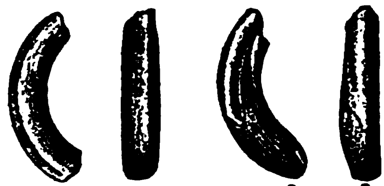
Based on No. **258**, 1892.

***348. Lydekker, R.—On a Mammalian Incisor from the Wealden of Hastings.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 281, 282.

The specimen was found by Sir John Evans in a block of stone, at Hastings. It is curved, and the anterior face has a thick coating of enamel, which is absent on the sides and opposite face. The summit exhibits the oblique wear characteristic of Rodent teeth, and the lower end seems to have been open; the exposed surface is flattened, while the other side is convex and bevelled, so that the former is the inner aspect. There is thus nothing to distinguish the tooth from that of a Rodent. The author, however, thinks it is improbable that any true Rodent should have been in existence at that time, and that it is more likely that the animal was a *Bolodon*, seeing that a similar tooth is referred by O. C. Marsh to the synonymous genus *Allodon*. If it requires a specific

name it should be called *B. Evansi* (spec. nov.) [fig. 6]. As to its horizon, Mr. C. Dawson cannot identify the matrix with



1. 1a. 2. 2a.

FIG. 6.—Mammalian tooth (*Bolodon Evansi*) from the Wealden of Hastings, twice nat. size.

any rock known to him from the Hastings district, and the block was not found *in situ*.

BIRDS.

349. Wallis, H. M.—The Evolution of the Bird.

Ann. Rep. Brighton and Sussex Nat. Hist. Soc., 1892–3, pp. 10–14.

Abstract of a lecture on the forerunners of recent birds.

REPTILES.

*350. Seeley, H. G.—Further observations on the Shoulder Girdle and Clavicular Arch in the Ichthyosauria and Sauropterygia.

Proc. Roy. Soc., vol. liv. pp. 149–168.

Replying to Mr. J. W. Hulke [No. **261**, 1892], the author does not consider that the embryology of types belonging to other orders can elucidate the structure of extinct forms, as it cannot be shown that the different orders' follow the same laws of development. The structure of the shoulder girdle is figured in the Oxford Clay type *Ophthalmosaurus*. It is argued that the pre-coracoid was unossified in all Ichthyosaurs. The pre-coracoid is unossified in *Nothosaurus*, and thereby the shoulder girdle differs from *Pareiasaurus*. In Plesiosaurs the pre-coracoid cartilage appears to be lost. The interclavicle and clavicles are recognized in Ichthyosaurs, Nothosaurs, Anomodonts, and Plesiosaurs, occupying the same relative positions.

*351. Newton, E. T.—On some Dicynodont and other Reptile Remains, from the Elgin Sandstone.

Rep. Brit. Assoc. for 1892, pp. 723, 724.

A preliminary account of the discoveries described in No. **352**, also published in 1892 in the Geological Magazine [*see* No. **268**, 1892].

***352. Newton, E. T.—On some New Reptiles from the Elgin Sandstones.**

Phil. Trans. B. 89, vol. clxxxiv. pp. 431–503, plates xxvi.–xli.; also Proc. Roy. Soc., vol. lii. pp. 389–391. Reviewed by R. Lydekker, in Natural Science, vol. iv. pp. 305–307.

A history of the discovery of reptilian remains in the Elgin sandstone is first given. The specimens here described are all new, and, with the exception of one belonging to *Pareiasaurus*, they are all Dicynodonts. They are from Cuttie's Hillock Quarry.

A.—DICYNODONTIA.

Gordonia (gen. nov.).—The generic characters in general are left to be gathered from the description of the species, but in particular they are: the possession of two large temporal fossæ on each side; the comparative slenderness of all the bones of the skull; the small size of the teeth; and the apparently imperfect ossification of the vertebral centra.

G. Traquairi, spec. nov. [fig. 7, 8*a*, and 8*b*].—The characters of the skull are obtained by taking gutta-percha casts of the interior of the hollow cavities left in the sandstone by the decay

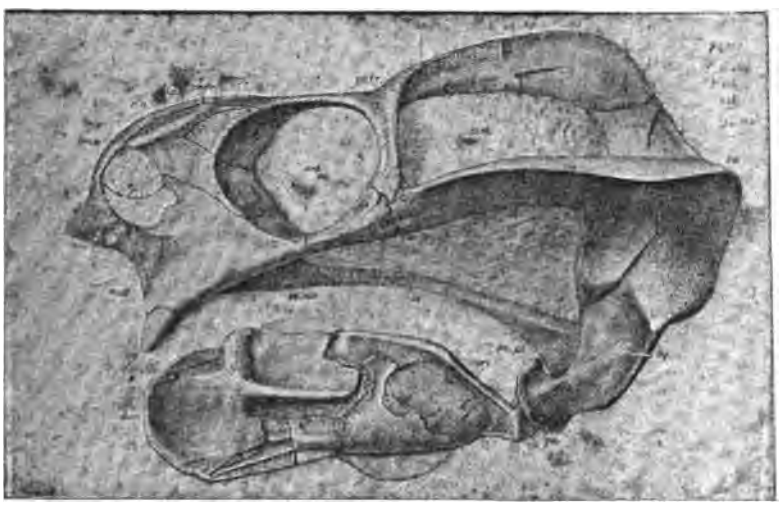


FIG. 7.—*Gordonia Traquairi*, from the Elgin Sandstone. Side view. ⅘ nat. size.

of the bones. The upper surface is regularly pear-shaped, the broad hinder end being occupied by a large supratemporal

FIG. 8.—The same. *a.* Upper side of skull. *b.* Under side of skull. ⅘ nat. size.

fossa on each side, which is bounded anteriorly by the post-orbital bone; from the hinder margin of this a crest runs backwards, almost meeting its fellow on the opposite side, and is supposed to be formed by bones which overlie the true parietals and are continuous with the squamosals. The parietal region between the crests is occupied by a spindle-shaped area composed of the two parietals behind and an intercalary triangular bone in front; the line of junction being near the anterior margin of a large oval pineal fossa, which forms a very distinct cup. Anteriorly to this are the two frontals with a median ridge, which meets the premaxillaries a little in front of the orbits. The front of the muzzle is possibly notched; the nasal, prefrontal, and lachrymal bones occupy the same relative position as in *Dicynodon*, as described by Cope.

On the side view the premaxilla forms apparently a beak-like projection and is joined without suture to the maxilla, which supports, and to a great part covers, a downward, forward, and inward directed tusk. The nasal opening is lateral, the orbit is directed outwards, forwards, and a little upwards, and is continuous below and behind with the great temporo-palatine vacuity; within it in front is the lachrymal foramen passing through into the nasal chamber. The squamosal includes the pedicle for the lower jaw, which begins at the top with a broad surface, but is constructed and twisted below. The quadrate forms the condyle, and from its inner side the pterygoid passes below the orbit to join the maxilla.

The under surface of the palate is concave from side to side, but convex, with a sutured crest, from back to front. The pterygoids behind make it triradiate; within their bases are a pair of foramina, and in front is a median, anteriorly pointed aperture which opens into the suprapalatine vacuity just behind the orbits, where it is divided by a median septum. The palatines, which originate in the front part of the aperture, nearly, or quite, meet in the middle line and form the posterior nares which lead into the nasal chambers, which themselves are separated by the ethmovomerine. The roof of the mouth in front forms a deep concavity. The brain-case below the pineal foramen must have been very small.

The mandible is shallow behind, but deepens in front, and is nearly straight. It shows a long oval vacuity inside and outside, and is convex above and concave below, but with a downward projecting plate of bone; the two rami were perfectly anchylosed. Some remains of a humerus and scapula are also observed. The nearest genus to this is *Dicynodon*, the most important bone for comparison being apparently the intercalary bone.

Gordonia Huxleyana, spec. nov. [fig 9*a*].—The skull is wider and more oval in outline, the parieto-squamosal crest is less conspicuous, the palatal foramina are more clearly divided, and the entire skull is more depressed. Remains of ribs, ilium, scapula, clavicle, and humerus are also preserved.

Gordonia Duffiana, spec. nov. [fig 9*b*].—The parieto-squamosal crest is wider than in *G. Huxleyana*, and the spindle-shaped area is larger and the width of the skull greater than in *G. Traquairi*. The back of the skull is seen in this species. The supraoccipital region is vertical, and is continuous laterally with the broad squamosal plate. From the lowest part of the exoccipital region a broad bar of bone extends outwards to the quadrate, bounding below a post-temporal fossa, which is separated above by the opisthotic from the upper fossa. No vertebral centra can be certainly made out, but neural arches are traceable, and 16–17 long and flattened ribs may be counted; four vertebræ formed the sacrum; the ilium, parts

of the pectoral arch, and an ungual bone and two phalanges are shown.

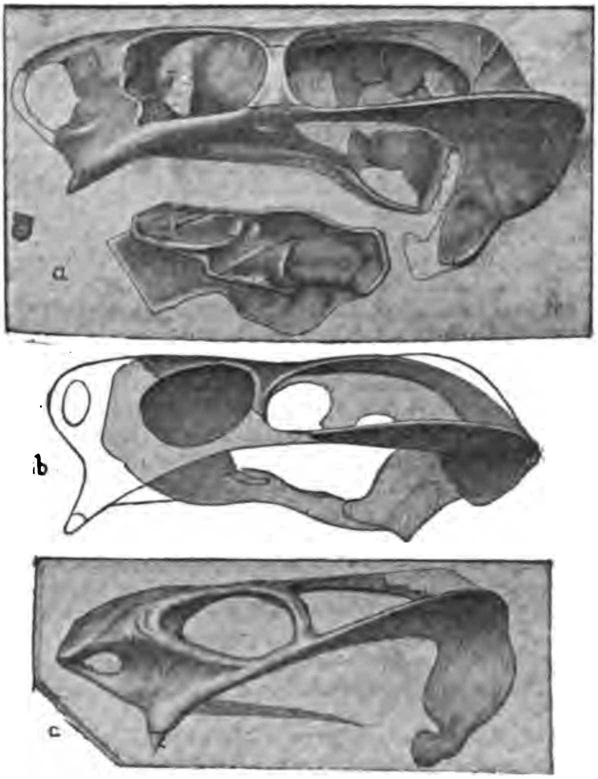


FIG. 9*a*.—*Gordonia Huxleyana*. 9*b*. *Gordonia Duffiana*. 9*c*. *Gordonia Juddiana*.

From the Elgin Sandstone. ⅔ nat. size.

Two other specimens, referred respectively to *G. Traquairi* and *G. Huxleyana*, are next described.

Gordonia Juddiana, spec. nov. [fig. 9*c*].—In this species the bones above the nasal region are more thickened, the nasal opening is smaller, the tusk further back and more downwardly directed, and the pineal fossa not so large. The parieto-squamosal is not so much developed as in *G. Traquairi*. The occiput has two large post-temporal fossæ on each side, the occipital condyle is tripartite, and the lateral segments extend upwards on each side of the foramen magnum, while from the outer side extends a process abutting on the quadrate and

pierced by a foramen. The foramen magnum has the form of a reversed keyhole.

Geikia, gen. nov.—The characters must be determined from those of the species, the most important being the extreme breadth and the absence of tusks.

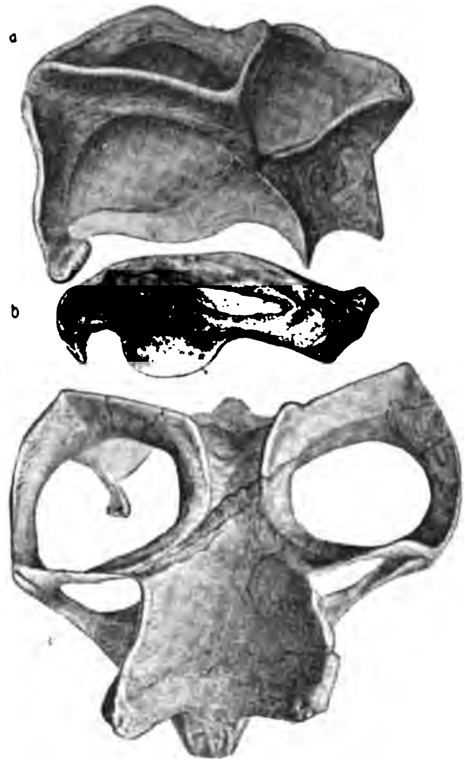


FIG. 10.—*Geikia elginensis.* From the Elgin Sandstone. *a.* Side view of skull. *b.* Side view of mandible. *c.* Upper view of skull. ½ nat. size.

Geikia elginensis, spec. nov. [fig. 10].—The front bones are rugose, and the skull is without sutures. The temporal fossa is round, the intertemporal space wide, and the interorbital space wider. This is raised on each side into a prominent ridge overhanging the orbit and terminating anteriorly in a horn-like process projecting over the nasal opening, the space between the ridges being quadrate. From the hinder end each ridge curves downwards to join the temporal bar. There are the usual parieto-squamosal crests, which do not approximate. The premaxillæ form a kind of beak. The pedicle for the lower

jaw is very long. The maxilla has its lower edge directed downwards and forwards, but ends in a toothless point. The orbit is triangular, the upper margin being straight. In front of, and below, the orbit is a quadrate area with a cutting edge below. The pterygoid is shorter and deeper than in *Gordonia*. The palate has essentially the same structure as in other Dicynodonts; the roof in front is deeply vaulted, with a thickened edge in the centre, above which is an ethmovomerine septum dividing the nasal chamber. The back of the skull is very wide and flat. The foramen magnum is large and oval. There is a prominence on the right side of the basi-occipital corresponding to the hypapophysis; each exoccipital is perforated by a large foramen, and extends outwards and downwards to abut on the quadrate, and immediately above is a large post-temporal fossa. The upper part of the occiput is a broad plate of bone confluent with the squamosal ridges. The lower jaw shows the characteristic fossa and broad plate of bone projecting from below; the two rami are co-ossified at the symphysis, where the bones are rugose, and the upper front margin on each side is produced into a warty tooth-like prominence. This and the maxillæ were probably covered by a horny beak.

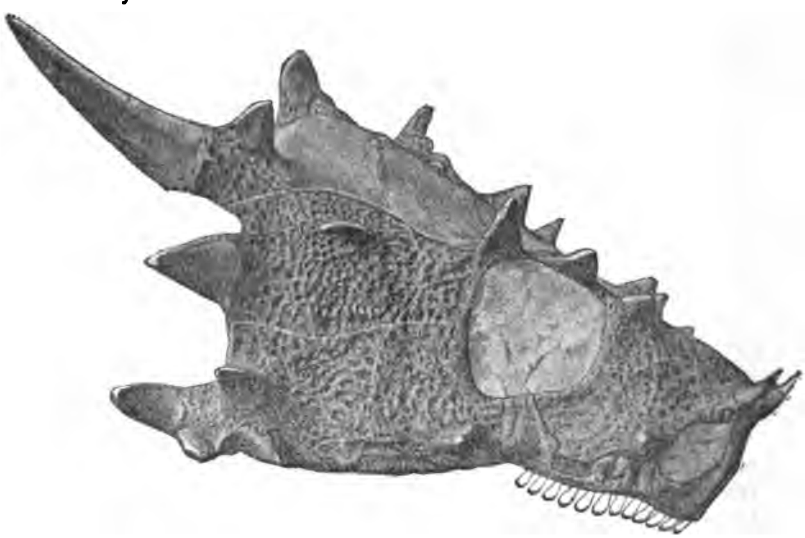


FIG. 11.—*Elginia mirabilis*. From the Elgin Sandstone. Side view of skull. For front view see frontispiece. $\frac{4}{5}$ nat. size.

B.—PAREIASAURIA.

Elginia, gen. nov.—The characters taken from the species *E. mirabilis*, spec. nov. [frontispiece and fig. 11]. On the

surface of the skull the only apertures seen are the orbits, the nasal openings, and the pineal fossa. The lower temporal arcade is complete, but both the upper and lower temporal fossæ are entirely covered in by bone. The outer surface of all the bones, except the premaxillæ, is deeply sculptured with rounded pits. On each side of the skull there are 16 horns or spines, from a quarter to three inches in length, besides three bosses on each side of the parietal region. There is also a rounded spine in the middle of the forehead, and near the bases of the two nasal horns is a small median protuberance, making 40 projections in all, each of them showing longitudinal grooves and striæ. Seen from above or from the side the skull is triangular, the posterior upper corner being produced into the longest horns. The muzzle is deep and almost vertical. The large round nasal apertures look directly forward and are completely separated by the upward processes of the two distinct premaxillæ. Seen from above the two nasal horns are on the anterior portion of the nasal bone. The pineal fossa occupies the centre of the skull opposite the hinder margin of the orbits; it is large and oval. The outer bones of the skull behind it do not form the roof of the brain-case, but are separated from it by large temporal fossæ which open at the back. A vertical plate, occupying the position of the infraoccipital, connects the inner and outer covering; above and in front the median bone supports a spine and seems to be the interparietal, and behind there is a pair of bones with larger spines, which probably belong to the supraoccipital. The large horns are considered to belong to the epiotics, while the part between the pineal fossa and the epiotics is occupied by the squamosals and parietals.

In the side view a spine is seen behind the nasal opening, probably belonging to the maxilla, which extends back as far as the middle of the orbit; all the orbit is quadrate, and its top is overhung by three spines. The cheek behind this is nearly square and is divided by sutures into four areas: of the two anterior, one may be the post-orbital and the other the jugal, carrying a large spine below the orbit; and of the two posterior the lower represents the quadrato-jugal and quadrate with two large spines, and the upper the supratemporal with one large backward running spine.

The palate is formed on the Lacertian plan, and is short and wide. Near the front are two large apertures for the internal nares; on the rear and outer side the palate is uncovered, but there is a pterygoid bar passing to the quadrate region, and starting from a median aperture corresponding to the interpterygoid vacuity in *Iguana*. Four longitudinal ridges diverging from the front of the foramen run along the palate. The base of the cranium is very long and narrow, and deeply grooved behind, and the back of the skull is very

broad. The teeth resemble those of *Iguana*, and are set along a parapet in a pleurodont manner; there are spaces for 12 on each side. The author considers that the forward position of the posterior nares, the character of the opisthotic and exoccipital processes which form a strong buttress extending to the pedicle of the lower jaw, and the peculiar dentition are all Lacertian characters, but the other features make it quite distinct from that group. The nearest ally is the South African *Pareiasaurus*. A description of some detached vertebræ and sacrum, and a discussion on the stratigraphical position of the Elgin sandstone, conclude the memoir.

353. Newton, E. T.—On the Reptilia of the British Trias.

Geol. Mag., Dec. 3, vol. x. pp. 555-557. (Read at B. A.)

This is a review of our knowledge of the reptiles which have been recorded from the Triassic strata of Britain. These are: the teeth of *Palæosaurus*, *Thecodontosaurus*, *Cladyodon*, and *Teratosaurus*, from Durdham Down; *Rhynchosaurus*, from Grinshill; and *Hyperodapedon*, from Warwick and Devonshire. In the Elgin sandstone have been found *Hyperodapedon*, *Telerpeton elginense*, *Stagonolepis Robertsoni*, *Dasignathus longidens*, and the remains more recently discovered, as described in Nos. **352**, **354**. The two latter are said to be related, the one to *Stagonolepis*, and the other to *Aetosaurus*.

***354. Newton, E. T.—Reptiles from the Elgin Sandstone. Description of two new Genera.**

Proc. Roy. Soc., vol. liv. pp. 436, 437.

One of these is a Parasuchian named *Erpetosuchus Granti*, gen. et spec. nov., represented by a skull about 3 in. long, the anterior part of the body, with pectoral arch and both forelimbs. The skull is depressed, and has supratemporal fossæ; the orbits are surrounded by bone, each having a large prelachrymal fossa and small forward nasal openings. The palate is narrow and deeply grooved. The posterior nares are forwardly situated, the teeth are variable, slender, conical, recurved, and only on part of the upper jaw. The vertebræ are slightly biconcave; the scapula is long and slender, the coracoid short and wide, and there is an interclavicle. The humerus has a strong pectoral crest, and is crocodilian in form. The radius and ulna are slender. There are five metacarpals, and above the vertebræ is a double row of small, pitted, closely-set scutes.

The second is a theropodous Dinosaur named *Ornithosuchus Woodwardi*, gen. et spec. nov. Except the forelimbs the remains are complete. The skull, which closely resembles that of *Ceratosaurus*, is 4½ inches long, sharp anteriorly, and bird-like

above. On each side of the lateral nasal aperture is a large prelachrymal fossa, a wide orbit, and an infratemporal fossa. The teeth are variable, lanceolate, recurved, compressed, and serrated before and behind. The palate is deep, and the posterior nares far back; there are 13 presacral, biconcave vertebræ, a sacrum of 3 vertebræ, 21 caudals, with long hæmal and neural spines, ilium crocodilian, ischia long, pubes longer, tibia and fibula as long as femur, and crocodilian in form, 5 metacarpals, and many pitted scutes covering the neural spines.

***355. Lydekker, R.—On the Jaw of a new Carnivorous Dinosaur from the Oxford Clay of Peterborough.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 284–287, plate xi.

The fragments here described are only freshly severed, and belong to one lower jaw about one foot long. The anterior fragment shows the dentary bone roughened and pitted exteriorly, with a broad symphysial channel. The symphysis is oblique, and was obviously united by ligament. The alveolar surface is bent in the middle, and slopes down to the symphysis. Its length is pierced by 19 complete alveoli. Only replacing teeth are left, which arose interiorly, a feature which distinguishes the animal from the crocodiles. The crown of the tooth was laterally compressed with trenchant, serrated fore and aft edges, a sharp point, and a vertical ridge on the outside. The total number was probably 22. The hinder portion of the jaw has the usual features characteristic of theropodous Dinosaurs, while the teeth, etc., distinguish it from the other groups of Dinosaurs. In its general characters it is nearest to *Thecodontosaurus*, but being distinguished from that genus by the deflection of its alveolar margin, the author assigns it the new name of *Sarcolestes Leedsi**, gen. et spec. nov. Though resembling *Priodontognathus Phillipsii*, Seeley, in some of its characters, there is no evidence of their identity.

***356. Seeley, H. G.—On *Omosaurus Phillipsii* (Seeley).**

Ann. Rep. Yorkshire Phil. Soc. for 1892, pp. 52–57.

The author describes a femur found in 1838 in the Coralline Oolite of Slingsby. It is shown to belong to *Omosaurus* by its straight compressed shaft, in which there is no appreciable twist, by the proximal trochanteric edge, by the absence of a trochanter on the middle of the inner side of the shaft, and by the forms, proportions. and characters of its proximal and distal ends. This bone differs from the corresponding one in *O. durobrivensis* in having the proximal end relatively rather narrower and being relatively wider below the articular surface, the trochanteric ridge is not prolonged so far proximally, and the distal end is relatively much narrower. In *O. armatus* the bone

[illegible] and widens at [illegible] the same [illegible] and is [illegible] as it is possible that [illegible] the same species as the [illegible] has [illegible] named [illegible] save [illegible]

[illegible]. Lydekker, R.—[illegible] Two [illegible] Teeth from [illegible]

[illegible]

[illegible] The [illegible] from the [illegible] The [illegible] The [illegible] from [illegible] but he now refers both [illegible]

***358. Seeley, H. G.—On a Reptilian Tooth with two Roots.**

Ann. and Mag. Nat. Hist., 6, vol. [illegible] pp. [illegible]

Among the twelve isolated teeth of *Nuthetes* and two fragments of jaw obtained by the British Museum with the [illegible] is a single tooth* which distinctly shows two roots in anterior and posterior positions. It is 7 mm. long and shows no marginal serrations.

***359. Seeley, H. G.—Supplemental Note on a Double-Rooted Tooth from the Purbeck Beds in the British Museum.**

Ann. and Mag. Nat. Hist., 6, vol. xii. pp. 274–275.

On further consideration, though this tooth resembles those of *Nuthetes*, it also has some resemblance to the crown of a canine of one of the small mammals from the Purbeck beds. Now Prof. Marsh affirms that the canines in the allied genera of America often have divided roots. Prof. Osborn has affirmed the same of certain English genera, one of which, *Triconodon ferox*, is here figured, though it does not yield conclusive evidence. The question which of these two anomalies is illustrated by this bifanged tooth must therefore be left for future discovery.

***360. Lydekker, R.—On a Sauropodous Dinosaurian Vertebra from the Wealden of Hastings.**

Quart. Journ. Geol. Soc., vol. xliv. pp. 276–279.

The author has previously stated his belief that the vertebræ described as *Ornithopsis* belong to the same species as a tooth called *Hoplosaurus*, and hence has assigned the latter name to the vertebræ also [*see* No. **394**, 1890]. He has now received a dorsal vertebra from the Isle of Wight, which differs in several respects from the vertebra thus called *Hoplosaurus*. Its lateral cavity is of a different shape, and the vertical partition in it is differently situated, as is also the V bounding the first triangular hollow on the side of the arch. Hence, as this new vertebra does not belong to *Hoplosaurus*, and has the same ochreous tint as the bones called *Morosaurus Becklesii*, the author considers that it must be referred to that animal, and as he considers this to be identical with *Cetiosaurus brevis*, from Cuckfield, he calls the new vertebra *Morosaurus brevis**.

FISHES.

***361. Woodward, A. S.—Note on the Evolution of the Scales of Fishes.**

Natural Science, vol. iii. pp. 448–450.

According to Prof. Ryder the scales of fishes should have been originally disposed in a series of rings round the body, but as motion became freer these rings should have been replaced by rhombic scales. Now in *Cephalaspis* such a ring of six or seven scales is actually found surrounding each segment of muscle—each ring overlapping the one behind; towards the tail, however, where there is more motion, the scales become smaller and rhomboidal. In a New Zealand fish, *Aetheolepis*, allied to the Liassic *Dapedius*, a regular succession of different kinds of scale, from rhomboidal, with peg and socket in front, to perfectly round or cycloidal on the tail, is seen, and there is a tendency in the same direction in the *Endactis* of the English Lias. In *Misturus* of the Oxford Clay, the scales are joined both above and below by a dentated suture, so as to form an almost inflexible scale armour. In the *Palæoniscidæ* the fishes with cycloidal scales have thick rhombic ones in the upper lobe of the tail; in the Devonian fringed finned ganoids—the *Holoptychiidæ*—with these more primitive fins, are associated round overlapping scales, but many with more specialized fins—the *Osteolepidæ*—have rhombic scales, while *Megalichthys*, with rhomboid scales, passes into *Rhizodopsis* with round scales.

362. Traquair, R. H.—On the discovery of *Cephalaspis* in the Caithness Flags.

Annals of Scottish Nat. Hist., vol. ii. pp. 206, 207.

The specimen is from the pavement quarry at Spital, ten miles from Thurso, and is now in the Edinburgh Museum.

It is the largest known species. The snout is pointed, and the cornua are comparatively broad and short-based. The orbits also are smaller and farther apart than in *C. campbelltownensis*. The surface ornament is an excessively minute and close tuberculation. It is named *C. magnifica*, spec. nov., but is not figured.

***363. Traquair, R. H.—A new Fossil Fish from Dura Den.**

Annals of Scottish Nat. Hist., vol. i. pp. 233–235 (1892).

The form of this fish is long and narrow, and shows posteriorly two dorsal fins. The cranial bones are covered with a fine rugose granulation. The gape is wide, but only a few conical teeth are exposed; the palato-pterygoid bone has the usual Rhizodont shape; the scales are thin and rounded, and have the usual fine concentric and radiating markings of the Rhizodonts. By a comparison of this specimen with another from the same beds, showing the hinder part of the body and tail of a Rhizodus, it is concluded that the species may belong to the genus *Gyroptychius* and it is named *G. Heddlei*, spec. nov. No figure is given, but the fossil is preserved in the St. Andrew's Museum.

***364. Traquair, R. H.—On the British Species of *Asterolepidæ*.**

Proc. Roy. Phys. Soc. Edinburgh, vol. xi. pp. 283–286.

Further examination of the forms of *Pterichthys*, of which five had been distinguished by the author in 1888, shows that two should be considered synonyms, as should also *P. latus*, Eg. Thus only three British species are now admitted, viz. *P. Milleri*, *P. productus*, and *P. oblongus*. The species of *Bothriolepis* previously admitted were *B. major*, *B. hydrophilus*, *B. macrocephalus*, *B. obesus*, and *B. giganteus*: the last of these is now considered to be synonymous with *B. major*, for the proper arms having been discovered it is now proved that its supposed arms belong to another species now called *B. leptochirus*, spec. nov. The plates of the body are rather thin; the exposed surfaces are covered with a rather delicate reticulo-tuberculate ornament. The arms are slender, the articular plate of the upper arm having its greatest breadth $\frac{4}{7}$ of its length (instead of $\frac{1}{3}$, as in *B. major*). From the Upper Old Red Sandstone. Heads of Ayr.

The other remains of *Asterolepidæ* are *Asterolepis maximus* and *Microbrachius Dicki*.

***365. Traquair, R. H.—A further description of *Palæospondylus Gunni*, Traquair.**

Proc. Roy. Phys. Soc. Edinburgh, vol. xii. pp. 87–94, plate i.

The author describes some new specimens of this curious fish from the Caithness Old Red Sandstone, of which he gives figures and a restoration [fig. 12]. The present information is summarized as follows:—

1. Cranium simple. No distinctly differentiated bones. On the ventral surface (which alone has been seen) it consists of two parts—the anterior, comparable to the trabecular and palatal part of the lamprey's skull; the posterior part, comparable to the parachordal part and auditory capsules. The anterior margin shows several pointed processes or cirrhi, but no traces of jaws.
2. Immediately behind the head are two small oblong plate-like bodies of unknown homology, which lie on each side of the vertebral column.
3. The notochordal sheath is calcified in the form of ring-shaped centra, with neural arches, produced towards the tail into spines, and at the same place there are hæmal spines. No ribs, nor paired limbs.

The supposed oral ring is an appearance due to weathering, and there is no lower jaw. On the whole the author is rather surprised that the "startling idea" of its marsipobranchiate affinities should have been so readily accepted, though he can find nothing against it [*see* No. **405**, 1890].

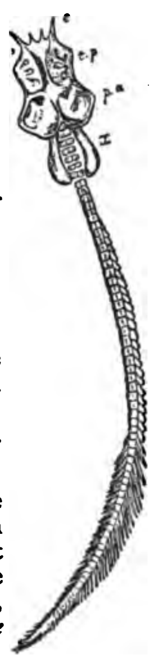


FIG. 12.—*Palæospondylus Gunni.* From the Old Red Sandstone, Caithness. Nat. size.

*366. Woodward, A. S.—Supposed Fossil Lampreys.

Natural Science, vol. iii. pp. 128, 129.

Draws attention to the restoration of *Palæospondylus Gunni*, by Dr. Traquair, in No. **365**.

367. Traquair, R. H.—On a New Palæoniscoid Fish, *Myriolepis hibernicus*, spec. nov., from the Coal-measures, co. Kilkenny, Ireland.

Geol. Mag., Dec. 3, vol. x. pp. 54–56, plate iii.

There are two specimens from Jarrow Colliery, the one figured being in the Manchester Museum. The head is typically Palæoniscoid, ⅛ the whole length preserved. The body was covered with exceedingly small rhombic scales, with

only feeble traces of striæ. They were exceedingly thin, and allow the typically Palæoniscoid skeleton to be seen through them. The fins are rather small, the pectorals and ventrals are composed of articulated rays, the anal is triangular, acuminate, and also with close articulated rays. The length preserved is 7½ inches, and depth 3 inches. The species may be provisionally referred to *Myriolepis*, till it is known whether the fin-rays in that genus were as completely articulated. In any case the species itself is new, and is called *M. hibernicus**, spec. nov.

368. Heath, A. J., and Lloyd-Morgan, C.—On the Fish Remains of the Lower Carboniferous Rocks, of the Bristol District.

Proc. Bristol Nat. Soc., vol. vii. pp. 80–92.

Gives a general description of the fish remains of the district. The occurrence is noted of a tooth referable to *Psammodus angustus*, Romanowsky, of which a figure is given. It is thought that the spines called *Ctenacanthus* and the teeth called *Orodus*, which are both the largest of their kind in the Bristol area, may belong to the same animal. A list of 20 teeth and 7 spines is added.

***369. Woodward, A. S.—Palæichthyological Notes.**

Ann. and Mag. Nat. Hist., Dec. 6, vol. xii. pp. 281–288, plate x.

I. On some Ichthyolites from the Keuper of Warwickshire.

A second example of *Ceratodus lævissimus**, represented by a left upper tooth, is figured from the Lower Keuper, Coton End. *Phœbodus Brodiai**, spec. nov., very small teeth.—The crown consists of three robust conical cusps, vertically striated towards the apex, and about equal in width at the base; the roots are horizontally expanded, and overlap when in series. These teeth are referred to the American Cladodont genus *Phœbodus*, which ranges from the Middle Devonian to the Lower Carboniferous. Upper Keuper, Shrewley.—A large spine of "*Hybodus Keuperinus**" from the Upper Keuper of Shrewley is figured. It agrees with the spines of Mesozoic hybodonts, and differs from those of all known Palæozoic forms in having the posterior denticles within the postero-external margin.

II. On *Nemacanthus monilifer* from the Rhætic formation.

***370. Woodward, A. S.—On the Cranial Osteology of the Mesozoic Ganoid Fishes *Lepidotus* and *Dapedius*.**

Proc. Zool. Soc., 1893, part iii. pp. 559–565, plates xlix., l.

The specimen of *Lepidotus*, on which most of the present observations are based, is the type of a new species from the Oxford Clay of Peterborough.

*L. latifrons**, spec. nov.—"External head and opercular bones ornamented with conspicuous tuberculations; all the teeth with much elevated crowns; premaxilla with six teeth; each frontal bone twice as long as its maximum breadth; operculum three times as long as broad."

The main body of the paper consists of detailed descriptions of the various skull bones in this species and the Liassic *Dapedius*.

In conclusion, the author says that the study of these extinct fishes renders it impossible to recognize any absolute division of the so-called ganoids into *Lepidosteidæ* and *Amioideæ*. The skulls of *Lepidosteus* and *Dapedius* differ from those of existing ganoids in exhibiting the backward extension of the basicranial canal. Both *Lepidotus* and *Dapedius* agree with *Lepidosteus* and *Amia* in the non-extension of the membrane bones quite to the occipital border of the cranium; but *Dapedius*, at least, is distinguished from *Amia* and approximated to *Lepidosteus* by the course of the olfactory nerves across the orbital cavity; while *Lepidotus* is paralleled by the latter in the absence of a gular plate. On the other hand, the superficial bones of the two extinct genera agree only with those of *Amia*, *e.g.* in the attachment of the premaxilla in *Lepidotus*.

***371. Woodward, A. S. — On some British Upper Jurassic Fish Remains of the genera *Caturus*, *Gyrodus*, and *Notidanus*.**

Ann. and Mag. Nat. Hist., 6, vol. xii. pp. 398–402, plate xviii.

The type specimen of *Caturus angustus** (Ag.) from the Portland Oolite of Garsington is here for the first time figured and fully described; also *Gyrodus punctatus**, Ag., from the Lower Calcareous Grit, Malton, showing its splenial and vomerine dentition, and *Notidanus Munsteri**, Ag., from the Oxford Clay of St. Ives—a tooth.

***372. Woodward, A. S.—Some Cretaceous Pycnodont Fishes.**

Geol. Mag., Dec. 3, vol. x. pp. 434–436 and 487–493, plates xvi., xvii.

I. On ARTHRODON.—For the greater part of the first paper see Foreign Geology, No. 632. Two species are British.

Arthrodon intermedius, spec. nov. [fig. 13*b*].—Splenial bone comparatively elongated, with large, closely arranged teeth, mostly smooth and nearly circular, a few exhibiting an apical

pit, with feebly crumpled margin disposed in five or six irregular series, the largest forming a principal series near the symphysial margin of the bone. Purbeck, Aylesbury.

A. crassus, spec. nov. [fig. 13*c*].—Splenial bone short and broad, with large, widely spaced teeth, mostly circular, disposed in about four irregular series, largest near the middle of the bone. Cambridge Greensand.

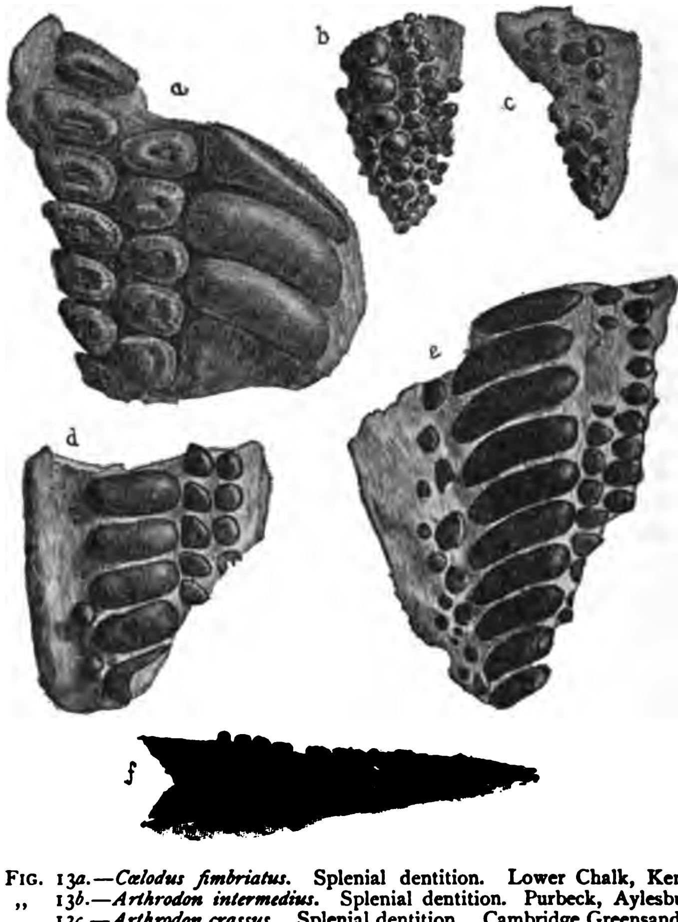


FIG. 13*a*.—*Cœlodus fimbriatus*. Splenial dentition. Lower Chalk, Kent.
,, 13*b*.—*Arthrodon intermedius*. Splenial dentition. Purbeck, Aylesbury.
,, 13*c*.—*Arthrodon crassus*. Splenial dentition. Cambridge Greensand.
,, 13*d*.—*Cœlodus inequidens*. Splenial dentition. Cambridge Greensand.
,, 13*e*.—*Anomœodus superbus*. Splenial dentition. Cambridge Greensand.
,, 13*f*.—*Anomœodus Willetti*. Vomerine dentition. Turonian, Sussex.

All nat. size.

A vomerine bone* from the Cambridge Greensand is also figured, but not described.

II. On the genus ANOMŒODUS, with remarks on the structure of the Pycnodont skull.

The genus *Anomœodus*, Forir, is thus defined: Head bones with reticulated rugæ. Smaller teeth usually indented, principal teeth quite smooth, or with a very feeble linear indent. Vomerine teeth in 3–5 series, splenial dentition separated from the oral border; one principal series, with one row at least within, and two or more without. Scales robust, with reticulating rugæ, only found in advance of the median fins. To this genus the following British species belong:—

A. subclavatus (Ag). = *Gyrodus angustus*, Ag. Sussex Chalk.

A. superbus, spec. nov. [fig 13*e*].—Principal teeth slightly arcuated. Length = ⅓ breadth. Inner teeth in two rows, the more central largest; outer teeth in three rows, smooth. Cambridge Greensand.

A. Willetti, spec. nov. [fig. 13*f*].—Small, teeth very irregularly arranged both on splenial and vomerine bones, nearly all indented, the smaller ones with a conspicuous pit with crenulated margins. The skull shows that—(1) the vomer is single; (2) the mandibular suspensorium is strongly inclined forwards; (3) the pterygo-palatine arcade is delicate, toothless, and fused throughout the greater part of its length with the base of the skull; (4) the parasphenoid has a deep inferior lamellar keel; (5) the articulation of the mandible is very deep and narrow; (6) there is a large superficial bone apparently identifiable with the pre-operculum. Turonian, Sussex.

III. Description of the splenial dentition of two new species of *Cœlodus*.

C. inæquidens, spec. nov. [fig. 13*d*].—The teeth of the principal series have a breadth greater than twice their length, and are wider than the two flanking rows, of which the inner is the larger, and both as broad as large. Within the principal series is a row of a few minute round teeth. All the teeth smooth. Cambridge Greensand.

C. fimbriatus, spec. nov. [fig. 13*a*].—Principal teeth smooth or feebly crimped round the margin, somewhat less than three times as broad as long, equalling the two outer series. These are nearly equal in size, irregular in form, broader than long, and with a deep coronal pit, with crimped margin. Lower Chalk, Kent.

IV. Some undetermined specimens of vomerine dentition. Two vomers* from the Cambridge Greensand and one from the Greensand of the Isle of Wight are figured, without names being assigned. The vomer of *Pycnodus scrobicularis**, Reuss, from the Chalk of Charing, is also figured.

MIXED INVERTEBRATES.

373. Bell, A.—Notes on a Post-Tertiary Deposit in Sussex [*see* No. **218**].

Ann. Rep. Yorkshire Phil. Soc. for 1892; Notes on Fossils, pp. 73–79.

The following new species are described and figured:—

*P. scabriusculus**, spec. nov., small, pure white, near to *P. varius*, but rays 26, sparsely scaled, intervals crossed by regularly placed, raised, imbricated scales, auricles rayed, umbo pointed. Size, 4 mm. × 2 mm.

*Cardium inæquale**, spec. nov., more oblique and more inequilateral than *C. papillosum*, 21–22 flattened costæ, sparsely tuberculated, deeply punctured in the intervals, test somewhat oblong, anterior side short.

*Solariella acutangula**, spec. nov., compressed above and below, spire slightly elevated, apex immersed, whorls 4–5, enlarging rapidly downwards, with 6–7 concentric ridges of unequal thickness above the periphery, and 5 in the large open umbilicus, suture deep, mouth angular. Size, 2 mm. × 4 mm.

*S. approximata**, spec. nov., small, spire depressed, whorls 3–4, flattened above, rounded at the side, with 3–4 sharply moulded spiral ridges, the outer one largest, 3–4 below, suture distinct, mouth obliquely rhomboidal. Size, 1·25 mm. × 2 mm.

Cithna minima, spec. nov., shell a short conic oval, whorls 4, angulated on the body whorl, apex depressed, suture deep, mouth nearly circular, base expanded, pillar-lip curved, canal long and narrow.

*Hydrobia compactilis**, spec. nov., smooth, solid, whorls 5–6, apex blunt, next two whorls round and swollen, mouth oval, outer lip thickened outside, inner lip thin, straight, barely continuous, base imperforate.

*Rissoa bicarinata**, spec. nov., body whorl half the shell, sharply angulated at the periphery and less so on the shoulder, outer lip with a varix.

*R. scutula**, spec. nov., ornamented on the upper half of the whorl with close-set, long, oval, scute-like markings, depressed in the centre, outer lip with a varix.

*R. multistriata**, spec. nov., tapering rapidly, suture well-defined, whorls with close-set spiral striæ, and swollen costæ on the upper part, outer lip thin.

*Barleeia cingulata**, spec. nov., whorls flat, mouth patuliform.

*Odostomia elongata**, spec. nov., whorls flatly convex, aperture pear-shaped, outer lip straight, one strong columellar tooth.

*Sphenotrochus selseyensis**, spec. nov., margin of calyx arched in the longer direction, septa strong, columella large, costæ moderately thick, thickest near the sides, base pointed.

CEPHALOPODA.

*374. Blake, J. F.—On the Bases of the Classification of Ammonites.

Proc. Geol. Assoc., vol. xiii. pp. 24–39, plates i., ii. (Reviewed in Nat. Science, vol. iii. pp. 140–145.)

This is a presidential address, consisting of various observations on questions relating to Ammonite classification. Ammonites differ amongst each other in their form, size, ornaments, sutures, aperture, aptychus, body chamber, and first chamber; but only the first four of these are here dealt with.

I. The form depends on (*a*) the amount of curvature, (*b*) the involution, (*c*) the thickness of the whorl, and (*d*) the shape of the transverse section. The true curvature, which is given by the ratio of the two parts into which any diameter is divided by the centre, is often greater in the open-whorled *Crioceras* than in the involute *Phylloceras*; and this is illustrated by an imaginary Ammonite, in which, while the same external curvature is preserved, we can, by filling in the central part differently, produce the general appearance of various genera. There are always irregularities of curvature in the earlier whorls, and as increase of curvature depends on the relative growth of the inner and outer part of a radial section, it is suggested that these changes of curvature may be connected with epochs in the life-history of the animal. Ammonites are necessarily more evolute when young, so that this feature can scarcely have any phylogenetic significance. The increase in thickness is independent of the curvature, and its amount gives us compressed and depressed forms, corresponding to the longicones and brevicones among *Orthocerata*. The increase is always more rapid in youth, and we must not on that account consider depressed forms as more ancestral; for instance, the oldest *Orthocerata* are longicone.

II. The size is an element of some importance, for a giant type can scarcely be the near descendant of a dwarf. Moreover, both are specialized, and not therefore so elastic as should be the progenitors of a vigorous race; dwarfs are degenerate and giants difficult to maintain, so that they are liable to perish at their acme.

III. The ornaments are naturally more simple in the young shell, and it must not therefore be concluded that the development of a group always commences with a simple form. The result of making such an assumption is that "even the very evidence that has led to the acceptance of the doctrine of evolution we are bidden to ignore; the similarity between the various forms, which has convinced us that they cannot be disconnected genetically, we are told is mere homoplasy"—the exhibition of "morphological equivalence," and that

similar forms may have no genetic connection, except by way of some "*Ammonites miserabilis*," as one of these supposed ancestors is appropriately called. If the polyphylogeny of similar, misnamed homoplastic, forms were proved, it would become a question whether morphological equivalence was not of much more interest and importance than genetic connection. Suggestions are then made as to how certain Ammonites may have been derived otherwise than *de novo* from a simple form. Attention is next drawn to the similarity of certain Triassic and Cretaceous types, the connection between which is not clear, but three alternatives are mentioned. They may have been living elsewhere meanwhile, or they may have arisen twice from simple types, or old types may have changed again and again into similar forms.

IV. Sutures in part depend on the shape of the shell, and in part are independent of this, in which latter case only can they be guides to affinity. The sutures of Triassic Ammonites are distinguished as *serial*, in which the lobes generally decrease in size towards the inner side; *centro-serial*, in which there are two or three extra large ones in the centre of the whorl; and the *normal*, to which alone the usual special terms for the different parts properly apply. There is also an intermediate type called the *serio-normal*. The *Trachyostraca* have normal sutures, and this is one ground for considering them the progenitors of Liassic forms. When the sutures of these become more complex, the complexity is not that of multiplication, but that of arborescence. Special forms of normal sutures are called *palmate*, as in *Lytoceras*, *protense* as in *A. tripartitus*. The independence of sutures and ornaments is seen from the fact that *A. Achilles* and *A. communis* are similar in ornament but different in sutures, while *A. raricostatus* and *A. lamellosus* are similar in sutures but different in ornament. It is thought that the connecting laws have not yet been made out.

*375. Foord, A. H.—Claim of Priority.

Geol. Mag., Dec. 3, vol. x. p. 288.

S. A. Miller proposes the name *Streptodiscus* for *Nautilus stygialis*, but the author used this species as the type of his new genus *Cœlonautilus*, in 1891, which name has therefore priority over Miller's.

*376. Gwinnell, W. F.—Cephalopods, Recent and Fossil.

Western Micr. Club Abs. Proc., 10th Session, pp. 7–9.

A popular account.

***377. Foord, A. H., and Crick, G. C.—On a New Species of *Discites* (*Discites hibernicus*) from the Lower Carboniferous Limestone of Ireland.**

Geol. Mag., Dec. 3, vol. x. pp. 251–254.

The new species was found in the Carboniferous Limestone near Dublin, and must not be confounded with *Nautilus hibernicus*, D'Orb. *Discites hibernicus*, spec. nov. [fig. 14].—Discoid,

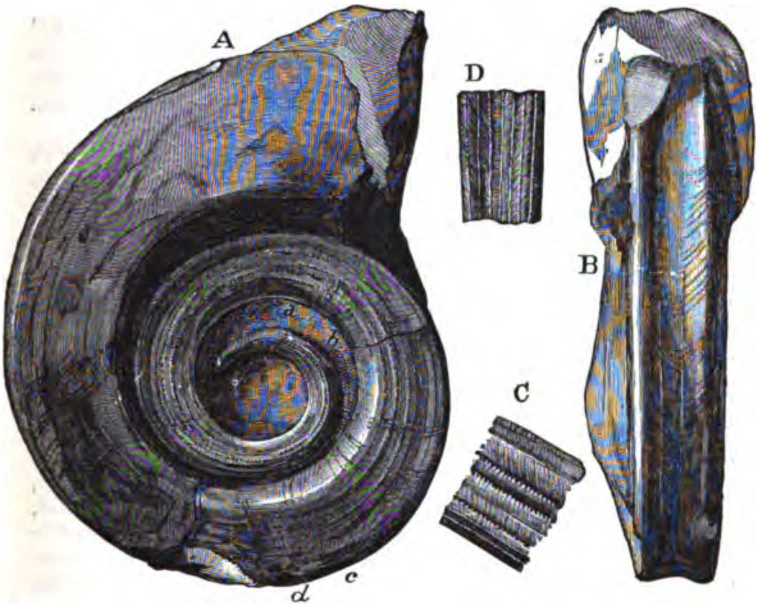


FIG. 14.—*Discites hibernicus*. Lower Carboniferous Limestone, Ireland. Nat. size. *a*. Side view. *b*. Outer view. *c* and *d*. Details of sculpture.

compressed, whorls rather more than two, the first half whorl free, the rest only just in contact; whorl subcircular in section in the young, subquadrate in the adult; periphery convex in the free portion, concave in the last whorl; sides flattened; surface of the young shell, also the inner and a portion of the outer whorl, ornamented with longitudinal, mostly crenulated, lines; the last whorl, with backwardly directed lines of growth, forming a sinus on the periphery.

***378. Buckman, S. S.—A Monograph on the Inferior Oolite Ammonites of the British Islands, part iii. pp. 345–376, plates lxxvii.–xcii.**

Pal. Soc. for 1893.

Continues No. 281, 1892.

*Sonninia biplicata**, spec. nov.—At the beginning of the costate stage pairs of strong ribs alternate with weaker ones; later on the stronger are single. *Concavum* zone, Bradford Abbas.

*S. alternata**, spec. nov.—Has similar alternations of ribs, but is more compressed, more involute, and with a more marked inner margin and less ornamented. *Concavum* zone, Bradford Abbas.

The next group described is called "the *crassa* stock." The forms possess nearly upright ribs, even during the spinous stage, but they differ from the *dominans* stock in being thicker and more spinous in proportion to the size of the umbilicus. These form two parallel series of four forms each.

*S. crassiformis**, spec. nov.—Whorls elliptical, at first with strong regular spines on obscure ribs, which divide into two or three beyond the spines; at a later stage they have large single, direct "bullicostæ" or bullate ribs. This is one of the largest forms. *Concavum* zone.

*S. crassa**, spec. nov.—Whorls oblong, with rather close, direct, upright, undulate, inclined ribs, obscure ventrally, spinous on inner whorls; inclusion $\frac{1}{3}$. *Concavum* zone, Bradford Abbas.

*S. crassinuda**, spec. nov.—Whorls oblong, ribs and bulges few and irregularly placed; spinous and costate stages seen in the inner whorls; inclusion $\frac{1}{2}$. *Concavum* zone, Bradford Abbas.

*S. nuda**, spec. nov.—Whorls oblong, ventrally convergent, practically unornamented; inner margin broad, upright, flat, rounded on the upper edge; inclusion $\frac{1}{3}$. This is the morphological equivalent of *S. simplex*, but it possesses a carina for a longer time, and the umbilicus is less excentric and the whorls shelve outwards. *Concavum* zone, Bradford Abbas.

*S. crassibullata**, spec. nov.—Whorls rather flat-sided, with large coarse spines passing into "bullicostæ," and then into direct ventrally obscure ribs. Inner margin broad, flat, nearly upright; inclusion $\frac{2}{3}$. *Concavum* zone, Bradford Abbas.

*S. crassicostata**, spec. nov.—Like the last, but the changes in ornament are assumed at a smaller diameter, viz. at 70 mm. instead of 190 mm. *Concavum* zone, Bradford Abbas.

*S. diversa**, spec. nov.—Whorls circular to oblong; earlier ornaments are slender; tall, closely packed, regular spines, the later ones direct; irregularly placed costæ, which become obscure on the outer area. Inner margin nearly upright, flat; inclusion $\frac{1}{3}$. *Concavum* zone, Bradford Abbas.

*S. lævigata**, spec. nov.—Whorls oblong, with a few irregularly placed, obscure, direct, upright ribs; inner margin broad, steeply sloped; inclusion $\frac{4}{5}$. At first the whorls are thin, and then become thicker. *Concavum* zone, Bradford Abbas.

The next four forms are called the "*subdecorata* stock." They are dwarf and retrogressive.

The author here quotes a paper by himself and F. A. Bather, "On the Terms of Auxology," in the Zoologischer Anzeiger, Nov., 1892, in which they propose the following modifications of Hyatt's and others' terms for the stages of the life-history of an individual, and wish to use the same terms, each with the prefix phyl- or phylo- for the stages of the phylogeny, and with morpho- for the stages of the morphogeny.

Anaplasis	Embryonic Brephic Neanic	Epacme.
Metaplasis	Ephebic	Acme.
Cataplasis	Gerontic Catabatic Hypostrophic	Paracme.

*S. subspinosa**, spec. nov.—Whorls elliptical; in brephic stage with regular spines; in neanic and ephebic with costæ and irregularly placed spinicostæ, usually parted by 2–4 costæ, one rib leading to the spine and splitting up beyond; inclusion $\frac{1}{3}$; superior lateral lobe asymmetrical. The inner whorls have been previously figured as the young of *S. acanthodes*. *Concavum* zone, Bradford Abbas.

*S. decorata**, spec. nov.—In brephic stage with regularly set spines, in the neanic with reclining ribs, every third or fifth spined, and later every second or third slightly nodate and bifurcating beyond the node; inclusion $\frac{2}{3}$. *Concavum* zone, Bradford Abbas.

*S. subdecorata**, spec. nov.—Differs from the last by its smaller, more closely set ribs, which are sometimes connate on the inner and not on the outer third; also by its less thickness and the absence of nodicostæ; inclusion $\frac{2}{3}$. *Concavum* zone, Bradford Abbas.

*S. decora**, spec. nov.—With numerous ventrally-inclined ribs, occasionally obscurely connate on the inner edge; inclusion about $\frac{2}{3}$. *Concavum* zone, Bradford Abbas.

The next two forms are called the "*omphalica* stock": they are phylo-catabatic.

*S. euromphalica**, spec. nov.—Whorls nearly quadrate, at first with fairly regular spines, then irregular ones, then slightly bullate ribs, the remainder with direct, ventrally-inclined ribs; ventral area flattened, almost sulcate; inclusion $\frac{1}{3}$. Suture line simple. *Concavum* zone, Bradford Abbas.

*S. omphalica**, spec. nov.—In the brephic stage, as shown by a second specimen, subcircular, with small regular spines passing to nodicostæ and then to plain costæ; in the presumably ephebic stage elliptical, with distant ventrally-inclined ribs; ventral area flattened; inner margin in ephebic stage, smooth

and steep; inclusion $\frac{2}{3}$. Suture line simple, with broad-stemmed lobes, the superior lateral lobules presumably aborted, the cruciform arrangement not being shown. *Concavum* zone, Bradford Abbas.

The next three forms are called the "*quadrifida* stock," characterized by a symmetrically tripartite superior lateral lobe.

*S. spinosa**, spec. nov.—Whorls elliptical, with ventrally-inclined ribs of various sizes, an occasional larger one having a median spine and often bifurcating beyond it. Inner margin steeply sloped; inclusion $\frac{2}{3}$. *Concavum* zone, Bradford Abbas.

*S. quadrifida**, spec. nov.—Whorls oblong, showing regular and irregular spinous stages up to a diameter of 45 mm., then fairly close, not prominent; ventrally-inclined ribs, becoming more distant with age. Inner margin steeply sloping; inclusion $\frac{4}{10}$. *Concavum* zone, Bradford Abbas.

*S. papilionacea**, spec. nov.—Whorls oblong, slightly convergent ventrally, spinous stage ending at 28 mm., then with closely set, inconspicuous, ventrally-inclined costæ, becoming more distant and prominent with age. Inner margin nearly upright; inclusion $\frac{3}{10}$. In the superior lateral lobe the terminal lobule is long and the lateral lobules are tripartite. *Concavum* zone, Bradford Abbas.

The next three forms are called the "*paucinodata* stock," which is less spinous, and the lobules of the superior lateral lobe are asymmetrical.

*S. nodata**, spec. nov.—Whorls oval, with small subarcuate, much reclined, ventrally-inclined costæ, every second or third with a median knob; inclusion $\frac{1}{2}$. *Concavum* zone, Bradford Abbas.

*S. paucinodata**, spec. nov.—Whorls oblong, spinous stage ending at a diameter of 35 mm.; costæ small, subundulate, ventrally obsolete; inclusion $\frac{1}{2}$. *Concavum*-zone, Bradford Abbas.

*S. attrita**, spec. nov.—Whorls oblong, nearly smooth, with only ill-defined folds; spinous to 25 mm. diameter; inclusion $\frac{1}{2}$. *Concavum* zone, Bradford Abbas.

*S. palmata**, spec. nov.—Whorls elliptical, with ventrally-inclined, undulate, not very conspicuous costæ, which become more widely spaced with age; spinous to 60 mm. diameter; inner margin steep; inclusion $\frac{1}{2}$. Superior lateral lobe bifid, with the outer portion tridactyloid and the inner didactyloid. *Concavum* beds, Sherborne.

*S. densicostata**, spec. nov. — Whorls elliptical, with small, well-marked, ventrally-inclined costæ, and occasional larger ones with small knobs; inclusion $\frac{1}{2}$. No spines on the inner whorls. Inf. Ool., Beaminster.

*S. scalpta**, spec. nov.—Whorls at first with small regular spines, changing to small plain costæ, then becoming larger and more distant [description unfinished].

There are also figured, but not described in this part, the

following, all "spec. nov.":—*S. abnormis*, *S. multicostata*, *S. spinea*, *S. gibbera*, *S. contusa*, *S. reformata*, *S. mutans*, *S. locuples*, and *S. loculosa*.

PELECYPODA.

379. Hind, W.—On the Affinities of** ***Anthracoptera **and** ***Anthracomya*.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 249–275, plates vii.–x.

The author refers *Anthracoptera* to the *Mytilidæ*, and gives an amended generic description.

Anthracoptera.—Shell modioliform, obliquity triangular, inequivalve, both valves notched for the byssus. Hinge-line straight, hinge-plate obsolete or striate (edentulous).[1] Beaks almost terminal, umbonal ridge strong on left valve; post-adductor seat circular, large, near posterior end, ½ breadth from the superior border; anterior adductor small, pit-like, anterior to the umbo. Two accessory pit-like scars [abridged].

The species described are: *A. modiolaris** (Sow.), *A. triangularis** (Sow.), *A. carinata** (Sow.), *A. quadrata** (Sow.), *A. tumida**, R. Eth., jun., *A. obesa*, R. Eth., jun.

FIG. 15*a*.—*Anthracomya obovata.* 15*b*, *c*. *Anthracoptera elongata.* 15*d*. *Anthracomya lanceolata.* 15*e*. *Anthracomya carinata.* 15*f*. *Anthracomya angusta.* From the Coal-measures. Nat. size.
("*c*" and "*e*" are interchanged in the cut.)

A. elongata, spec. nov. [fig. 15*b*, *c*].—Distinguished by its tumid, elongated, subparallel form.

All other specific names are placed as synonyms, except *A. Browniana*, which is rejected from the genus, and it is suggested that it may be a *Posidonia*.

Anthracomya is referred to the Unionidæ, and an amended generic definition given.

Anthracomya.—Transverse, inequivalve, inequilatoid, tumid near the umbones, which are small and near the anterior end,

[1] Since withdrawn.

posterior end expanded and generally truncate. Hinge-line straight, edentulous; no pallial sinus, no byssal notch observed; ligament external. Many of the species gape. Periostracum wrinkled. Interior with radial striæ, anterior adductor at the upper angle of the shell, posterior adductor near the end of the hinge-line [abridged].

They are never found associated with marine forms, nor standing vertically, and hence it is concluded that they had a fresh-water habitat, and were not burrowers.

The species described are: *A. Adamsii**, Salter, and var. *expansa*. Hind; distinguished by its produced and rounded inferior border and obsolete anterior end; *A. dolabrata** (Sow.); *A. Phillipsii** (Williamson); *A. scotica**, R. Eth., jun.; *A. modiolaris** (Sow.).

*A. elongata**, nom. nov. for *A. Williamsoni* (Brown).[1]

A. lanceolata, spec. nov. [fig. 15*d*].—Distinguished by the absence of a raised hinge-line posteriorly and by the acute and generally flattened posterior end.

*A. obtusa** (Ludwig); *A. subcentralis**, Salter; *A. pumila**, Salter; *A. senex**, Salter.

A. angusta, spec. nov. [fig. 15*f*], has a narrow elongated form, surface with fine concentric lines reflected upwards at the posterior end. Unique. New to Britain.

A. obovata, spec. nov. [fig. 15*a*], looks very like, and perhaps is a mimic of, *Anthracoptera*. Unique. New to Britain.

*A.**, spec. nov. ? may be a variety of *A. modiolaris*; *A. Wardi**, Eth.; but that author described a broken specimen as a complete one; the umbones are ¼ the length from the anterior end.

*A. minima**, nom. nov. for specimen figured but not named by Salter. Iron ores of South Wales, plate ii. figs. 1–3.

A. carinata, spec. nov. [fig. 15*e*], has a strong oblique swelling, transverse form, short anterior end, and rounded posterior end.

*380. Hind, W.—Note on *Myalina crassa* (Fleming).

Geol. Mag., Dec. 3, vol. x. pp. 514, 515.

The shells described by Fleming as *Mytilus crassus* and referred to *Myalina* by R. Etheridge, jun., do not show the rostral myophores and terminal umbones of the Myalinas of the Permian, and they cannot really be distinguished from *Anthracoptera*, which, as the author has shown, possesses the striated hinge of *Myalina crassa*. Hence that species ought to be called *Anthracoptera crassa*.

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[1] According to the author's synonymy, this name *elongata* is preoccupied by *Naiadites elongata*, Dawson, which he refers to *Anthracomya*. At a later date he returns to *A. Williamsoni*.

***381. Hind, W.—Description of a Slab from the Shale above Kinder Scout Grit, Rabchester, Lancashire, obtained by R. H. Tiddeman, Esq., M.A., F.G.S.**

Geol. Mag., Dec. 3, vol. x. pp. 540, 541.

The specimen is in the British Museum, and is here figured. It consists of a piece of fossil wood, to which the shells are attached, doubtless by their byssi. These shells can be made out to belong to *Anthracoptera*, the shell structure of which they show.

***382. Whidborne, G. F.—A Monograph of the Devonian Fauna of the South of England. Vol. ii. part iii. pp. 89, 90.**

Pal. Soc. for 1893.

Finishes description of *Lyriopecten fibratus*, and describes *Crenipecten oceani* (Goldf.).

***383. Newton, R. B.—Note on some Molluscan Remains lately discovered in the English Keuper.**

Geol. Mag., Dec. 3, vol. x. pp. 557.

The remains in question come from the Upper Keuper Sandstone of Shrewley, where they were discovered by P. B. Brodie and E. P. Richards. They are Pelecypods, associated with *Estheria minuta*, and the teeth and spines of *Acrodus keuperinus*. They are named *Thracia ? Brodiæi*, spec. nov., *Goniomya keuperina*, spec. nov., and *Pholadomya Richardsi*, spec. nov., but are not described. In any case they belong to genera nowhere else recorded from rocks of this age.

BRACHIOPODA.

***384. Crane, Agnes.—The Distribution and Generic Evolution of some Recent Brachiopoda.**

Natural Science, vol. ii. pp. 46–53.

An account is here given of the conclusions of Fischer and Œhlert, after an examination of the Brachiopoda obtained in the expeditions of the "Travailleur," "Talisman," "Romanche," and "Hirondelle." It appears amongst other things that some species of *Megasella* and *Waltonia* are immature *Terebratellæ*, that the latter pass into *Magellaniæ* (*Waldheimia*), and that these arrested stages are capable of reproduction. "Many such grades were arrested and became stable during geological periods, *e.g.* *Centronella*, *Magas*, *Terebratella*, and possibly *Ismenia*."

***385. Crane, A.—New Classifications of the Brachiopoda.**

Geol. Mag., Dec. 3, vol. x. pp. 318–323.

An account of the memoir of C. Schubert in the "American

Geologist," from which it appears that he divides the Brachiopoda into the sub-classes *Lyopomata* and *Arthropomata* of Owen, and the sub-orders *Atremata*, *Neotremata*, *Protremata*, and *Telotremata* of Beecher. The *Protremata* are divided into *Trullacea* and *Thecacea*, and the *Telotremata* into *Rostracea*, *Helicopegmata*, and *Anchylobrachia*. A revision of the families of the loop-bearing Brachiopoda was issued simultaneously by C. E. Beecher, by whom this group is divided into the two families *Terebratulidæ* and *Terebratellidæ*, with seven sub-families. These classifications are of a morphogenetic character.

***386. Whidborne, G. F.—A Monograph of the Devonian Fauna of the South of England. Vol. ii. part iii. pp. 91–160, plates xi.–xvii.**

Pal. Soc. for 1893.

The Brachiopoda form the subject of this part. They are: *Magellania Whidbornei** (Davidson); *M. juvenis** (Sow.); *Terebratula newtoniensis** (Dav.); *Centronella virgo** (Phill.); *Meganteris inornata** (D'Orb.); *Stringocephalus Burtini** (Defr.).

ENANTIOSPHEN, gen. nov.—Has a strong median septum in the ventral valve, bearing oblique dental processes, a small elevated beak with sharp ridges, a minute apical foramen, flattened geniculated valves and an unpunctured surface.

*E. Vicaryi** (Dav.); *Merista plebeia** (Sow.); *Athyris Glassi* (Dav.); *A. concentrica* (v. Buch.); *A. rugata*, Dav.; *A. newtoniensis*, Dav.; *A. bartoniensis*, Dav.; *Bifida Hunti*, Dav.

*B.? plana**, spec. nov.—Very small, flat, circular. Beak erect, not recurved, flat, prominent, with straight lateral margins, area triangular, flat, foramen apparently apical, rather large, and separated from the hinge by a high deltidium. Dorsal valve, with a broad shallow depression in the centre.

Retzia longirostris, Kayser; *Uncites gryphus*, Schl.; *Spirifera Verneuillii*, Murch.; *S. subcuspidata*, Schnur.; *S. undifera**, Röm.; *S. concinna**, Hall; *S. nuda*, Sow.; *S. curvata**, Schl.; *S. lineata*, Mart.; *S. simplex*, Phill.; *S. newtoniensis*, Dav.

*S. infima**, spec. nov.—Minute, with a slight linear fold on the front of each valve, dorsal valve flat, ventral very deep, hinge-line straight, as wide as the shell, with sharp lateral angles, area very broad, nearly horizontal, beak slightly recurved, surface smooth.

Spiriferina insculpta (Phill.); *Cyrtia Whidbornei*, Dav.; *Cyrtina amblygona* (Phill.); *C. heteroclita** (Defr.) and vars. *multiplicata* and *Demarlii*; *Glassia** *Whidbornei*, Dav.; *Atrypa reticularis** (L.); *A. desquamata* (Sow.); *A. trigonella**, Dav.; *A. aspera* (Schl.); *A. Leei* (Dav.); *A. flabellata*, Dav.; *Pentamerus brevirostris* (Phill.); *P. biplicatus**, Schnur.; *P. sublinguifer**, Maurer.

*Conchidium brittanicum**, spec. nov.—Ventral valve inversely cordate, beak extremely elevated, slightly incurved, flattened,

apex sharp, fissure large, triangular, bordered by a short area, surface of valve with small median depression and numerous rays.

Rhynchonella acuminata (Mart.); *R. reniformis* (Sow.); *R. pugnus* (Mart.); *R. triloba* (Sow.); *R. parallelipipoda** (Bronn); *R. implexa* (Sow.); *R. angularis* (Phill.); *R. anisodonta** (Phill.); *R. ogwellensis*, Dav.

R. triloboides, spec. nov.—Beak small, recurved narrow, ventral valve with a broad central sinus, dorsal with a broad low rounded fold, lateral margins deeply convex, ribs numerous, rounded, very irregular, not reaching the apex.

*R. neapolitana**, spec. nov. — Subglobose, dorsal valve swollen, with a strong median fold, ventral less convex, ribs 26, sharp, the largest in the fold irregular, and reaching the apex.

*Wilsonia omega**, spec. nov., spheroidal.—Beak rather large, narrow, recurved, dorsal valve evenly convex, with a low narrow fold, ventral rather deep, with oblique sides, lateral margins straight, front margin much elevated, forming a high rectangular sinus, ribs short and widely grooved near the margin.

*Wilsonia cuboides** (Sow.); *Camarophoria ascendens** (Stein.); *C. protracta* (Sow.); *C. lummatonensis* (Dav.); *C. rhomboidea** (Phill.); *C. Phillipsii** (Dav.); *C.* cf. *megistana* (Le Hon); *Davidsonia Verneuillii* (Bouchard); *Skenidium areola** (Quenst.); *Orthis striatula* (Schl.); *O. eifelensis* (De Vern.).

*O. pulcherrima**, spec. nov.—Transversely oval, almost equivalve, hinge-line straight, short, beaks incurved, ventral one with a broad triangular area, front margin of the ventral valve with a slight continuous sinus, ribs 25, elevated, subtriangular, crossed by striæ.

Orthotetes umbraculum (Schl.); *O. distortus* (Barr.); *Strophomena rhomboidalis* (Walch) and var. *analoga*; *Stropheodonta nodulosa** (Phill.); *S. irregularis** (Röm.); *S. interstitialis** (Phill.); *S. nobilis* (M'Coy); *Productella subaculeata* (Murch.).

*Productella fragarina**, spec. nov.—Rather longer than wide, beak prominent, hinge-line shorter than greatest length, dorsal valve deeply concave, the surface of the ventral valve with large close tubercles, bearing spines and arching out in concave lines from the umbo, the surface of the dorsal valve with corresponding pits.

*Chonetes hardrensis** (Phill.); *C. Phillipsii* (Dav.); *C. convolutus* (Phill.); *Crania proavia** (Goldf.).

*Discina peltastes**, spec. nov.—Rather large, slightly conical, elongate, oval, apex slightly posterior, internal pedicle area with a small tube, surface with very fine concentric striæ.

***387. Reed, F. R. C.—Woodwardian Museum Notes: Abnormal Forms of *Spirifera lineata* (Martin).**

Geol. Mag., Dec. 3, vol. x. pp. 249–251, plate ix.

Figures a series of specimens in which a mesial furrow of peculiar form is developed in both valves, causing indentation of the anterior margin and bilobation of the shell. The stages of this change are traced in detail from the smallest nick to a furrow more than half across the shell. Whether this is the result of disease of the mantle or of the pressure of some external body is left undecided.

***388. Walker, J. F.—On the Brachiopoda recently discovered in the Yorkshire Oolites.**

Ann. Rep. Yorkshire Phil. Soc. for 1892, pp. 47–51.

Further notes on *Thecidea ornata* and *Terebratulina substriata*, the discovery of which in Yorkshire was recorded in No. **297**, 1892, and in the Geological Magazine, 1892, p. 364 [omitted in vol. for 1892]. The latter shell occurs in the Lower Coral Rag of Suffield, and is named var. *suffieldensis*. A history of the varieties of the species is then given.

POLYZOA.

***389. Cole, G. A. J.—On *Hemitrypa hibernica*, M'Coy.**

Sci. Proc. Roy. Dublin Soc., vol. viii. pp. 132–144, plate viii.

After giving an account of the various difficulties that have arisen in the interpretation of this genus, the author gives a new diagnosis of the species *H. hibernica* by the aid of specimens from the Carboniferous Limestone of Gardenfred, near Tuam, co. Galway; transverse sections of which he has prepared.

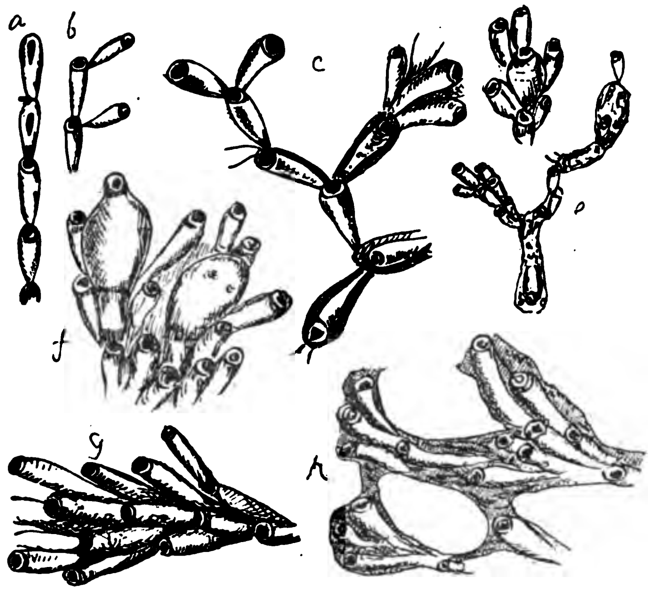
It is a Fenestelloid organism, with an outer sheath which the author calls the "tegmen." The zoarium is flabellate, with 20 fairly straight branches in 1 cm., ribbed on the reverse [or outer] side in the young, slightly keeled on the obverse [or inner] side, the keel being produced into pillars at intervals of about 5 mm. These pillars may be ·25 mm. long, and by their expansion at the distal ends form, parallel to each column, a slightly waved bar, which becomes an integral part of the tegmen, which has also "scalæ," having hexagonal-looking, but really circular, apertures, alternately arranged in double series, corresponding to the series of zoœcial pores that face that way. They are wider in diameter on the inner face, being about 40 per cm. either way. Three zoœcia correspond to one fenestrule. It is thought that the polypes emerged from the zoœcia in the direction of the tegmen, and put out their tentacles through the tegminal apertures.

390. Vine, G. R.—Notes on the Polyzoa—*Stomatopora* and *Proboscina* groups—from the Cornbrash of Thrapston, Northamptonshire.

Proc. Yorkshire Geol. and Polyt. Soc., vol. xii. pp. 247–258, plates xii., xiii.

After some general observations on the Cornbrash Polyzoa of the above-named groups, the following species are described :—

*Stomatopora Phillipsii**, spec. nov. [fig. 16*a*, *b*].—Zoarium encrusting, linear or branched, branches diverging from the distal end of the cell, generally in a line with the oral aperture; zoœcium pyriform, smooth, slightly prolonged at the base; length, $\frac{1}{80}$ in.



Polyzoa from Cornbrash of Thrapston.

FIG. 16*a*, *b*.—*Stomatopora Phillipsii*. *c*. *Stomatopora intermixta*. *d*, *e*. *Proboscina obscura*. *f*. *Proboscina ornata*. *g*. *Proboscina thrapstonensis*. *h*. *Proboscina divisa*.

*S. intermixta**, spec. nov. [fig. 16*c*].—Zoarium adnate, creeping, forming a series of reticulations; zoœcia of the ordinary uniserial type, but resting on a basal lamina, peristome raised, aperture orbicular.

S. dichotoma, Lamx.; *S. Waltoni**, Haime; *S. Desondini*, Haime.

*Proboscina obscura**, spec. nov. [fig. 16*d*, *e*].—Zoarium zigzag, adherent by the base, but slightly raised in the middle portion; zoœcia stunted, irregularly disposed, surface transversely banded or punctured, aperture circular at the extremity of the cell, peristome thin; oœcium ? lepralia-like, slightly distended in the central portion and punctured in transverse lines across the surface. Unique.

*P. divisa**, spec. nov. [fig. 16*h*].—Zoarium fenestrate, much branched, narrow, branches anastomosing at frequent intervals; zoœcia elongated or stunted, generally two or three on the surface of the branches.

P. clementina, Vine, var. *minuta**, nov., and *depressa**, nov.; *P. ornata*, spec. nov. [fig. 16*f*.].—Zoarium flabellate or irregular; zoœcia contiguous, rather larger than usual, cells thickly and minutely punctate, aperture circular; oœcia numerous, globular.

P. thrapstonensis, spec. nov. [fig. 16*g*.].—Zoarium flabellate or irregular; zoœcia depressed, contiguous by their whole length, nearly of equal breadth throughout, surface of cell flat, aperture circular with a thin, terminal, depressed peristome. In the younger cells the surface is densely punctate.

391. Vine, G. R.—Report of the Committee . . . appointed for the completion of a Report on the Cretaceous Polyzoa.

Rep. Brit. Assoc. for 1892, pp. 301–337.

The largest number of Cretaceous Polyzoa yet recorded is given in Prestwich's Geology published in 1888, and includes 114 species, of which 80 are of Upper Cretaceous age. The author has been enabled to examine a large series of species from "flint-meal" obtained by Mr. Gamble at Chatham, probably from the *Micraster* zones of the Chalk, details of which are given. He has also examined some washed chalk from Gravesend, and a series obtained by Dr. Blackmore from the *Psil. mucronatus* zone to the *Micraster coranguinum* zone at Salisbury. Separate lists from these two localities are given. The Polyzoa from other localities, the most northerly of which is Norfolk, have been previously recorded, but some of them the author has been able to re-examine. Putting all these together, we have here the most complete list of Cretaceous Polyzoa yet made. The author notes that in some cases he has used D'Orbigny's names, but he believes that in every such case the name represents a really distinct species.

The list includes 42 species from the Neocomian, 26 from the Cambridge Greensand, 7 from the Chalk detritus, 43 from the Red Chalk, 12 Upper Greensand, and 156 from the Upper Chalk, which with repetitions make a total of 250. References are given with each to the 21 works catalogued in the bibliography.

In this list *Stomatopora Dixoni* is a new name for *Alecto gracilis* of Lonsdale, *non* Edwards *nec* Brown. Ten are MS. names, and the following new species are described:—

Bitubigera cribriformis, spec. nov.—Zoœcia disposed idmonea-like, in two series, obliquely over half the zoarium; the interspaces between the rows are cribriform. Chatham. *Cribrilina*

linearis, spec. nov.—In habit like *Hippothoida brevis*, Rss., but cribriform. Chatham.

***392. Gregory, J. W. — On the British Palæogene Bryozoa.**

Trans. Zool. Soc. Lond., vol. xiii. pp. 219–279, pls. xxix.–xxxii.

The terminology is first noted. *Orifice*=opening of mouth, indeterminable in fossils; *aperture* = opening occupied by membrane surrounding the orifice—it may be primary, or secondary when the peristome rises into a tube; *sinus*=notch on the lower side of the aperture; *trypa* (new name)=pore perforating the front wall of the zoœcium in the *Microporellidæ*; *peristomial pore* = pore below the aperture; *punctures* = spaces between anastomosing spines; *areolæ*=pits in linear series around the margins of the zoœcia; *maculæ* (new name)=small irregular cavities in the walls of the zoœcia; *opesiulæ*=secondary small apertures.

The *Cheilostomata* are divided into the sub-orders—I. *Stolonata*, Busk; II. *Cellularina*, Smitt; III. *Athyriata* (new); IV. *Schizothyriata* (new); V. *Holothyriata* (new). The distinctions between the last three depend upon the state of calcification of the front wall. In the *Athyriata* the front wall is not completely, if at all, calcified. This sub-order includes the *Farciminariidæ*, *Flustridæ*, *Membraniporidæ*, *Cribrilinidæ*, *Microporidæ*, *Steganoporellidæ*, and *Cellariidæ*. In the *Schizothyriata* there is a notch or a trypa. This sub-order includes the *Schizoporellidæ*, *Adeonellidæ*, and *Microporellidæ*. In the *Holothyriata* the front wall is completely calcified. This sub-order includes the *Lepraliidæ*, *Celleporidæ*, and *Smithidæ*.

Order Cheilostomata.

*Notamia Wetherellii** (Busk). London Clay.

*Membranipora eocena** (Busk). Thanet Sand and London Clay.

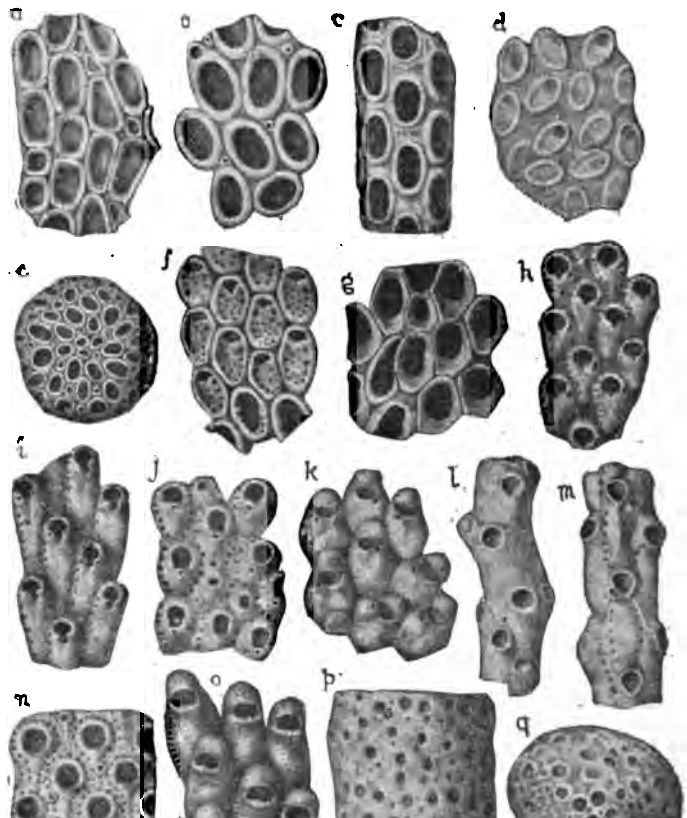
*M. Buski**, spec. nov. [fig. 17*a*], agrees with *M. Lacroixi*, Aud., but sometimes shows narrow globose oœcia. Headon beds, London Clay.

*M. crassomuralis**, spec. nov. [fig. 17*b*].—Zoœcia oval, each with a thick, prominent, plain ring, interspaces very narrow, opesia usually occupying the whole area; oœcia triangular, rimmed; a few avicularia. Barton and Bracklesham.

*M. tenuimuralis**, spec. nov.—*M. Lacroixi* is the species referred to by Busk, from which it differs in having avicularia, and a pair of tubercles in the margin of the zoœcia. London Clay.

*M. virguliformis**, spec. nov. [fig. 17*c*].—Zoarium cylindrical; zoœcia in regular, longitudinal series, elongate, rectangular; opesia large, with a smooth thick rim, a depressed front wall below the area, often with a pair of triangular depressions; no oœcia; avicularia single, on upper left-hand margin of oœcium. London Clay.

*M. disjuncta**, spec. nov. [fig. 17*d*].—Encrusting zoœcia, elliptical, arranged in disconnected rows; opesia large, with prominent rim, mouth at one end. The rest is covered with a thin lamina. London Clay.



British Palæogene Polyzoa.

FIG. 17—*a. Membranipora Buski* × 36. *b. Membranipora crassomuralis* × 21. *c. Membranipora virguliformis* × 16. *d. Membranipora disjuncta* × 8. *e. Biselenaria offa* × 9. *f. Micropora cribriformis* × 36. *g. Onychocella magno-aperta* × 27. *h. Schizoporella magno-aperta* × 24. *i. Schizoporella magno-incisa* × 20. *j. Umbonula bartonense* × 36. *k. Umbonula calcariformis* × 36. *l. Idmonea bialternata* × 36. *m. Smittia tubularis* × 36. *n. Trichopora clavata* × 36. *o. Mucronella angusto-œcium* × 36. *p. Hornera farehamensis* × 12. *q. Heteropora glandiformis* × 12.

*Lunulites transiens**, nom. nov. for *L. urceolata*, Lonsdale, *non* Lamarck.—Vibracularia large, clithridiate, enlarging towards the periphery, and there passing into normal zooecia. Barton and Bracklesham.

Biselenaria, nom. nov. for *Diplotaxis*, Reuss, preoccupied.

B. offa, spec. nov. [fig. 17*e*]. — Zoarium a circular disc, tapering circumferentially; opesia large, elliptical, with a thick margin; vibracularia irregularly distributed, with a thicker margin. On the under side the zooecia may be closed. Barton.

*Cribrilina Vinei**, spec. nov.=*Membraniporella nitida*, Johnst., var. *eocena* of G. R. Vine, the small pores in the furrows showing that the species belongs to *Cribrilina*. London Clay.

*Micropora cribriformis**, spec. nov. [fig. 17*f*].—Zoarium encrusting; zooecia oval, tapering below; aperture small, with a sinuous lower margin; the whole front and wall is cribriform. Barton.

*Onychocella magno-aperta**, spec. nov. [fig. 17*g*].—Zoarium encrusting, zooecia hexagonal; apertures slightly clithridiate, very large, restricted to a small lamina on the lower side; avicularia large, vicarious, long and tapering, irregularly scattered over the zooecium. Brockenhurst.

*Schizoporella magno-aperta**, spec. nov. [fig. 17*h*].—Zoarium foliaceous, zooecia pyriform, front wall turned, a raised lip round the oral orifice, sinus median, small, margin with a row of large deep areolæ. One avicularium to each zooecium, beside and below the orifice, with raised elliptic border. Barton.

*S. magno-incisa**, spec. nov. [fig. 17*i*].—Zooecia long and narrow, peristome raised, almost sub-tubular, aperture large, with a large sinus, one line of areolæ, front wall evenly convex, one lateral avicularium to each zooecium below the aperture. London Clay.

Schismoporella, gen. nov. for *Cellepora schizogaster*, Reuss, and its allies. It has both a sinus and a trypa—possibly the sinus is a second term of a series of sinuses, or a subdivision of a first one, or the genus is a primitive form.

*Adeonellopsis Wetherellii**, spec. nov. = *Microporella violacea* var. *fissa*, Vine.—Zooecia pyriform, peristome somewhat tubular, front wall with a cribriform areola; avicularia large, pointing obliquely upwards, close to the peristome. London Clay.

*A. incisa**, spec. nov.= *Microporella violacea* var. *fissa*, var. *a* Vine, a pair of avicularia form a peristomial pore, trypa a median slit, orifice suborbicular on a high tumid head. London Clay.

*Lepralia Lonsdalei**, nom. nov.=*E. Brongniarti*, Lonsdale *pars* (fig. 9). Bracklesham.

*Umbonula bartonensis**, spec. nov. [fig. 17*j*]. — Zoarium encrusting; zooecium pyriform, peristomial aperture semicircular, large, umbo on front wall on an avicularian cell, just below the aperture, areolæ round the margin. Barton.

*U. calcariformis**, spec. nov. [fig. 17*k*].—Front wall granular, tumid, with a lateral oblique avicularian cell, ending in a pair of sharp-pointed processes attached, pore raised and close to the zoœcial aperture, which is sub-orbicular. London Clay.

Trichopora, gen. nov.—A Lepralian with a simple orbicular aperture and thickened peristome; gonœcia instead of external marsupia.

*T. clavata**, spec. nov. [fig. 17*n*]. — Zoarium foliaceous, zoœcia clavate, orifice large, the surrounding ring continued on front wall, punctures large and numerous, one lateral avicularium below orifice, gonœcial orifice restricted either at the margin or by a central calcareous plate. Barton.

Meniscopora, gen. nov.—With simple primary orifice, usually biconvex in shape, lower margin flattest, gonœcia present, but no external marsupia.

*M. bigibberra**, spec. nov. = *Eschara Brongniarti*, Lonsdale, in Dixon's "Sussex," but it has the aperture wider than long, two humps, and a raised triangular area on the front wall. Bracklesham.

*Conescharellina clithridiata**, spec. nov.=" *Cellepora*, sp.", Wetherell.—Trans. Geol. Soc., ser. 2, vol. v. plate ix. fig. 21. London Clay.

*Orbitulipora petiolus** (Lonsdale). Bracklesham.

*Mucronella angusto-œcium**, spec. nov. [fig. 17*o*].—Zoœcia tumid, orifice sub-orbicular, peristome high and thickened; a simple mucro or lower margin, with the bases of two marginal spines; surface granular, about twelve areolæ round the lower end, oœcia numerous, granular, globose, but narrow. Barton, London Clay.

*Smittia tubularis**, spec. nov. [fig. 17*m*].—Zoarium narrow, cylindrical, dichotomously branching; zoœcia alternate, pyriform, front wall tumid, surface granular, secondary orifice orbicular or with a spout-like depression on the lower margin, peristome thin, a row of large areolæ round the margin; oœcia small, flattened, the lower side covered by the upper margin of the secondary orifice; avicularia large, lateral on a prominence below orifice. London Clay.

Order Cyclostomata.

*Idmonea Giebeli**, Stol.—London Clay. *I. seriatopora**, Reuss. —London Clay. *I. coronopus**, Defr.—Bracklesham.

*I. bialternata**, spec. nov. [fig. 17*l*].—Zoarium sinuous, evenly rounded in front, flattish at the back; zoœcia in two pairs, placed alternately, each pair opening close together. London Clay.

*Hornera farehamensis**, spec. nov. [fig. 17*p*].—Zoarium thick, dichotomous, but not anastomosing, with orbicular apertures in lines round the branches, and irregular crowded series in the middle line, apertures flush, inter-zoœcial pores two

or three times as many as the zoœcia, posterior side deeply perforate. London Clay.

*Entalophora tergemina**, spec. nov. = "*Idmonea gracillima*, Reuss," Vine. London Clay.

*Heteropora glandiformis**, spec. nov. [fig. 17*q*].—Zoarium small, globular, zoœcia crowded, bent tubes, orifice orbicular, with raised rim, secondary pores fewer, irregularly scattered. Barton and Bracklesham, London Clay.

Some general remarks and a bibliography of 150 works conclude the memoir.

INSECTS.

***393. Brodie, P. B.—Notes on the Eocene Tertiary Insects of the Isle of Wight.**

Geol. Mag., Dec. 3, vol. x. pp. 538–540.

The author states that in the Bembridge limestone some of the insects show the internal structure, *i.e.* the anatomy, of the animal, and in one instance even what appears to be the ovipositor, and in another the intestine, may be detected. He also announces that he has several thousand examples of Tertiary Insects which are awaiting description.

EURYPTERIDS.

394. Laurie, M.—Additions to the Eurypterid Fauna of the Upper Silurian.

Rep. Brit. Assoc. for 1892, pp. 724, 725.

A preliminary account of the discoveries detailed in No. **395**.

395. Laurie, M.—On some Eurypterid Remains from the Upper Silurian Rocks of the Pentland Hills.

Trans. Roy. Soc. Edinburgh, vol. xxxvii. pp. 151–161, with three plates.

The specimens examined are from Gutterford Burn, and are preserved in the Edinburgh Museum of Science and Art.

*Stylonurus ornatus**, spec. nov. [fig. 18*a*].—Carapace horse-shoe shaped with a nearly straight front margin, anterior edge bounded by a border of three parallel lines, sculpture of fine scale-marking on the central parts of the inturned portion. Eyes rather small within the inner margin of the inturned portion. Six free segments seen, posterior margin bordered, the sculpture as before. On the right side are seen plate-like abdominal appendages, and in the third and fifth segments are traces of branchial leaflets. On the dorsal surface are broad, flat scales, and a row of tubercles along the posterior margin; central lobe of genital plate club-shaped. Six posterior

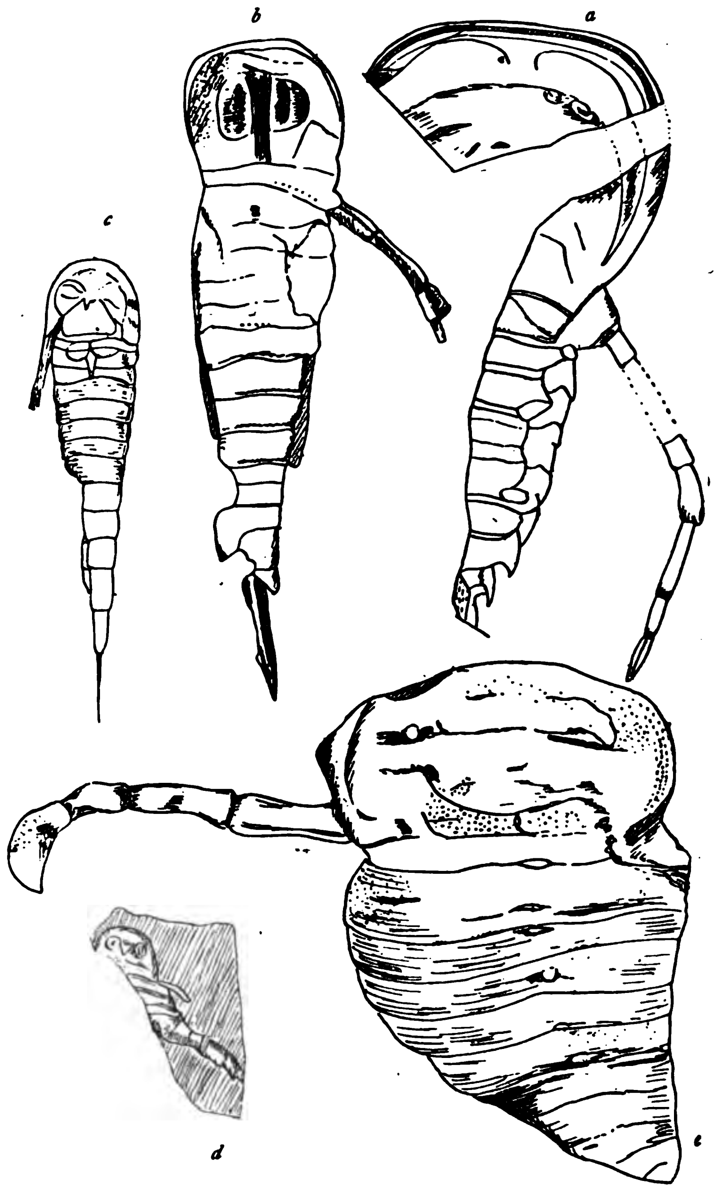


FIG. 18.—Upper Silurian Eurypterids from the Pentlands. *a. Stylonurus ornatus. b. Stylonurus macrophthalmus. c. Eurypterus conicus. d. Eurypterus cyclophthalmus. e. Drepanopterus pentlandicus.* All proportionately reduced.

segments and part of telson seen, all produced at the sides into curved epimeral plates at the posterior end. The last segment is very short, and has enormously expanded epimerites. An isolated end of a telson referred to this species ends in a point. The metastoma is comparatively long and narrow, with a deep groove down the centre. The only appendages preserved are a pair of long narrow legs on each side. There are two pairs of ectognaths with five conical teeth on the biting margin. The fifth joint of the leg is the longest, and its margin is obtusely crenulated. The penultimate joint has a spine, and the last is pointed.

Stylonurus macrophthalmus, spec. nov. [fig. 18*b*].—Smaller. Carapace horse-shoe shaped, margin with narrow border in front and a ridge down the centre. Eye-prominences half as long as the carapace; eye in curved band. Surface with curved scale-ornamentation, and the posterior border with a marginal row of tubercles. Body segments 12, narrowing and lengthening towards the posterior end, the posterior margin of each with a row of tubercles; the last segment with epimera. Telson long, narrow, with two longitudinal furrows. Metastoma straight behind, rapidly narrowing in front. Posterior limb, seen on the right side, very broad and short; a second limb seen in fragments. Two limbs seen on the left side, the second narrower, tapering to a point.

Eurypterus scorpioides, Woodward.

E. conicus, spec. nov. [fig. 18*c*].—Carapace semicircular. Eyes large, equidistant from the fore and hind margins of the carapace and near the edge. Ectognaths broad and angular; five pairs of post-oral appendages can be made out, and the position of the small cheliceræ. The body tapers regularly, the 12 segments increasing in length; the telson is long and pointed, and there are no epimera. The median lobe of the genital plate is of a pointed angular form; the lateral lobes are narrower than the segment, and their outer ends are rounded. Metastoma oval; no ornaments.

E. cyclophthalmus, spec. nov. [fig. 18*d*].—Small. Carapace semicircular, bordered in front; no scale-markings. Eyes large, subcircular, widely separated, rather towards the front of the carapace; between them two small central eyes. The body increases in breadth and then decreases, the earlier of the 12 segments being very narrow.

Drepanopterus, gen. nov.—Carapace broader than long, broadest at about $\frac{1}{3}$ from the anterior margin. First body segment broader than the posterior margin of the carapace, the following segments increasing in breadth to the third, and then diminishing rapidly. Limb elongated, subcylindrical, terminating in a very slightly expanding joint, concave on the posterior margin.

D. pentlandicus, spec. nov. [fig. 18*e*].—Carapace horse-shoe

shaped. Length to breadth as 4 to 7. Front margin bent downwards, scale-markings on the surface. Position of eyes doubtful, probably ⅓ its length from the front of the carapace. Nine broad body segments seen: the first segment tapers towards the side so as to be lost on the margin; the later ones have curved margins, overlapping backwards. In the centre of each of the first six is a protuberance. The telson tapers regularly to a sharp point, with a flat triangular area, contracting behind to form a ridge. Four distal joints of a limb seen, of length equal to that of the body; the first is hour-glass shaped, the second is concave behind, the third shorter, and the fourth falcate.

396. Laurie, M.—The Anatomy and Relations of the Eurypteridæ.

Trans. Roy. Soc. Edinburgh, vol. xxxvii. pp. 509–528, with two plates.

The author first revises the characters of the different genera.

Slimonia.—The carapace is subtriangular. There are two pairs of eyes, the central ones being non-facetted ocelli. The first seven free segments are composed of band-like tergites and sternites united by soft membrane, the last five are cylindrical sclerites. The telson ends in a spine which is triangular in section and appears like a weapon of offence. The subcordate metastoma appears to have been attached in the middle line, and to have extended in front and at the sides over the jaw-like bases of the posterior limbs, which thus worked in a more or less closed chamber. The basal joints of the "ectognaths" are retort-shaped and toothed. To the postero-external angle is attached the leg, which had apparently six joints, the penultimate one being long and rectangular, with a small triangular piece towards the inner margin. It is thought that this organ was more probably intended for digging out the sand than for swimming. The three legs next in front—the "endognaths"—have each a basal joint, with teeth along the inner margin and a six-jointed appendage, the joints bearing spines on their anterior margin. At the posterior end of the tooth-bearing edge, in some at least, a small process is articulated, corresponding to the epicoxite of *Limulus* and *Scorpio*. Next come a pair of endognaths which are specially modified for a tactile function, and these are undoubtedly post-oral, as the base is armed with teeth. To the basal joint is attached an elongated second, and four subcylindrical joints, making six in all. This appendage lies backward across the others, and corresponds to appendages in *Phalangium* and *Thelyphorus*. A pair of more anterior appendages, corresponding to the pincers of *Pterygotus*, has now been discovered. It is pre-oral in position and consists of a small pair of chelicerae,

which are curved so as to meet only at the apex. An epistoma can be made out. On the ventral surface there *appears* to be one fewer free segments, because there are no ventral sclerites on the first two, their place being taken by the large genital plate, consisting of a central and two lateral portions. A pair of anterior triangular areas may represent the paired

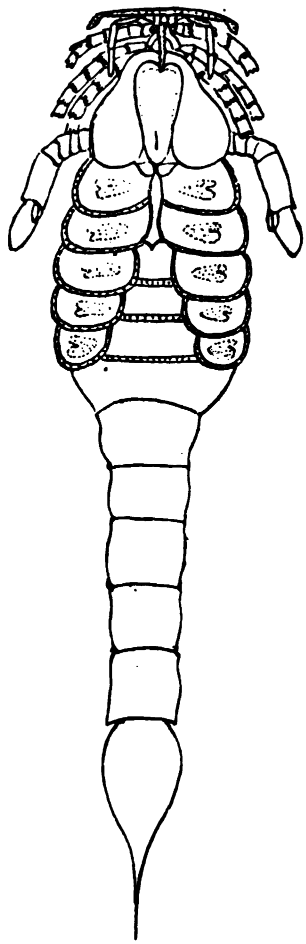


FIG. 19.—Restoration of *Slimonia*.

sternita of the first abdominal segment, the rest of the plates being appendages firmly fixed to it. The median lobe

is undoubtedly genital in function, and may either end in three sharp points or by a truncated cone, largest posteriorly where it is transversely marked by two or three deep furrows, which the author cannot believe to represent the ends of distinct overlapping plates. In this case the second free segment may be in relation to certain appearances which the author regards as remains of branchial leaflets, but which, as he states, Prof. Young considers to be muscular markings on the inside of a limb; the surface of these is covered by branched ridges, taken to represent the course of blood-vessels. From various specimens it is concluded that the abdominal appendages consisted of a series of plate-like structures, probably four in number, each of which bore, on the side next the body, one or more branchial lamellæ. A restoration of the ventral side is attempted [fig. 19].

Pterygotus has a semicircular carapace, the compound eyes are marginal, and there is a pair of nearly central ocelli. The body is less differentiated into two regions. The telson varies in form, being either spathulate, with a short spine or ridge, bilobed and oval, or round or square. The epistoma is much better developed; it is thought that its front margin is not really straight, but that it is morphologically a portion of the carapace bent over. It is believed that the cheliceræ consisted of three joints only, a long straight proximal one and the two parts of the pincers; possibly they were retractile within the carapace and had no good articulation with the epistoma. At the posterior margin of the next four appendages there is an epicoxite; the remainder consist of six cylindrical spineless joints. The ectognaths, metastoma, and genital operculum are of fundamentally the same type as in *Slimonia*, and there is little certain to add about the rest of the animal.

Eurypterus has recently been well described by Schmidt. It is characterized chiefly by its eyes being on the dorsal surface of the carapace, and by its long spine-like telson. The last pair of appendages have their proximal joints narrower and more cylindrical, and the last two joints more expanded. The fourth pair of walking legs is longer than the other three, and has no spines, except the three end ones. Schmidt describes the first pair of appendages in *E. Fischeri* as jointed and filiform, but in *E. scorpioides* they seem to be chelate, and this may indicate a generic difference.

Stylonurus and the other genera have not yielded any new data. The relations of the various Eurypterids amongst themselves is next discussed, and various points which might indicate more primitive conditions are dealt with; but the only really definite points are: That the more central eyes of Eurypterids compare best with the trilobite eyes, unless the facial sutures of the latter are the real edges of the carapace; and that the similarity of the first four legs of *Pterygotus* to each

other shows that, in this respect at least, the genus was not the most specialized. As to the relations of Eurypterids to other groups, there is little definite by which they can be compared to Trilobites, except a general structural resemblance. In spite of their mode of respiration they are sharply marked off from the Crustacea by the structure of their branchiæ, by the segmentation of the body, by the position of the genital aperture, by the absence of anything representing the first antennæ, by the chelate structure of their one pair of pre-oral appendages, by the absence of the typical biramous structure of the appendages, and by the development for masticatory purposes of the last and not the first three of these. The discovery of pre-oral chelicerae, and of abdominal appendages, brings them still nearer to *Limulus*. The relations to *Scorpio* and other Arachnids are more or less speculative; but they appear more related to *Thelyphonus* than to *Scorpio*.

397. Laurie, M.—Recent additions to our knowledge of the Eurypterids.

Natural Science, vol. iii. pp. 124–127.

A brief account of the anatomy of this group, as at present known, particularly in connection with the author's work, as detailed in Nos. **395**, **396**. It is here considered that the Eurypterids are most nearly allied to the Arachnids, separating from them near the point of their union with the Crustacea.

TRILOBITES.

***398. Bernard, H. M.—Trilobites with Antennæ at last.**

Nature, vol. xlviii. pp. 582, 583.

The author rejoices over the finding of numerous specimens of *Triarthrus Becki* with antennæ, as described by W. D. Matthew, from the Hudson River shales, and discusses the effect of the discovery on our knowledge of the affinities of Trilobites. He considers that all Trilobites had antennæ, but in this particular case they happened not to have been tucked in under the body. These ventrally placed antennæ were inserted, approximately, one on each side of the labium. These facts establish the relationship of the Trilobites with the Apodidæ [*see* No. **306**, 1892].

***399. Bolton, H.—On the occurrence of a Trilobite in the Skiddaw Slates of the Isle of Man.**

Geol. Mag., Dec. 3, vol. x. pp. 29–31.

The specimen was found at Ballastowel, south-west of Ramsey. It is an intaglio cast, showing six thoracic rings, the

axis convex and of uniform width; pleuræ twice the width of the axis, grooved; pygidium a little more than half the length of the thorax, width twice the length, axis flattened, ending bluntly in the middle of the pygidium. It may be either an *Asaphus* or an *Æglina*; it is the first recorded fossil of any kind from these slates.

CRUSTACEA.

400. Grobben, K.—A Contribution to the Knowledge of the Genealogy and Classification of the Crustacea.

Ann. and Mag. Nat. Hist., 6, vol. xi. pp. 440–473.

Although "genealogy" is mentioned in the title, not a single fossil Crustacean is referred to, the whole being a speculation founded on the morphology of recent forms.

***401. Woodward, H.—Note on a new British Species of *Cyclus* from the Coal-Measures of Bacup, Lancashire.**

Geol. Mag., Dec. 3, vol. x. pp. 28, 29.

The specimen was obtained by Mr. Geo. Scott from the Ganister seam. The shield is nearly circular in outline, with a median ridge, and the posterior margin slightly notched in the centre; the lateral and posterior margins have a raised rim. Anteriorly there are four prominences, two on each side, and there is a smooth semicircular ridge interiorly on each side, uniting posteriorly with the median ridge. Within this again, on each side, are two shorter and broader oblique ridges. The surface is finely granulated. The species is nearest to *C. agnotus* of the Muschelkalk, but differing from it is called *C. Scotti**, spec. nov. [fig. 20].

FIG. 20.—*Cyclus Scotti.* A. Shield. B. Portion enlarged. From the Coal-measures.

***402. Reed, F. R. C.—Woodwardian Museum Notes.**

Geol. Mag., Dec. 3, vol. x. pp. 64–66.

A new species of *Cyclus*, allied to *C. Harknessi*, and called provisionally *C. Woodwardi**, spec. nov. [fig. 21], is here

FIG. 21.—*Cyclus Woodwardi.*

described. Buckler oval, 4½ lines long by 3¾ lines broad, 2¾ lines high; surface granulated. Shows a median ridge surrounded by an "outer fork," and higher up by an "inner fork." Outside the former is a shallow groove, beyond which is a row of small tubercles, which are wanting on the seventh pair of ribs; beyond this come the ribs, dying out towards the margin, the first pair being of double size. In front there are a number of large lobes, three median and two on each side, also a less developed row nearer the margin. The differences thus shown may possibly be only due to a difference of development.

***403. Smith, J.—Peculiar U-Shaped Tubes in Sandstone, near Crawfurdland's Castle, and in Goukha Quarry, near Kilwinning.**

Trans. Geol. Soc. Glasgow, vol. ix. pp. 289–292, plate x.

These tubes are found in three beds in a series of Carboniferous sandstones. They consist of a number of U-shaped tubes or dark markings of circular section, and look like a nest of beakers. The U's have their axes perpendicular to the bedding planes. Seeing that similar tubes are made by the Crustacean *Corophium longicorne* at the present day, the author thinks they are due to a similar animal which he designates *Corophioides polyupsilon**.

ENTOMOSTRACA.

***404. Jones, T. R.—Note on a Fossil Cypridinad from the South of the Lleyn.**

Quart. Journ. Geol. Soc., vol. xlix. p. 164 [*see* No. **464**].

*Cypridina Raisiniæ**, spec. nov. [fig. 22].—Body suboval, with a hook or notch at the anterior end, and a strong caudal

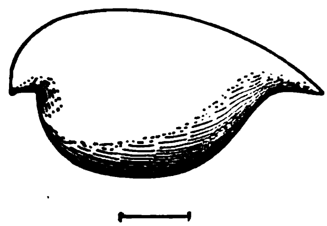


FIG. 22.—*Cypridina Raisiniæ.* The line shows the nat. size.

process posteriorly. Size 9 mm. × by 8 mm. It is from a mudstone, associated with the volcanic ashes, and is the oldest known Cypridinad.

***405. Jones, T. R.—On some Palæozoic Ostracoda from the District of Girvan, Ayrshire.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 296–307, pls. xiii., xiv.

The specimens are from Mrs. Gray's collection, and are mostly from the Upper Bala shales of Whitehouse Bay.

Aparchites leperditioides, Jones; *A. subovatus*, Jones.

*Primitia elongata**, Krause, var. *nuda*, nov., differs slightly from the type in the sulcus and pitting.

*P. Krausei**, spec. nov. [fig. 23*o*].—Anterior end subtruncate, posterior elliptical, sulcus short but distinct.

*P. girvanensis**, spec. nov. [fig 23*h*].—Dorsal edge straight, ventral elliptical, the free margin with a flattened rim, sulcus wide at the top and bordered anteriorly by an incipient lobe, surface punctate.

*P. Grayæ**, spec. nov. [fig. 23*n*].—Small, semioval, front margin of the sulcus much thickened, surface pitted.

P. mundula, Jones, var. *fimbriata**, nov., with a broad border and prickly posterior margin; also var. *Kloedeniana**, nov., elongate and with a thickened lip of the sulcus developed into a lobe.

*P. Ulrichiana**, spec. nov. [fig. 23*l*], with a boldly curved and expanding sulcus.

Beyrichia Kloedeni, M'Coy, and var. *infecta**, nov., with a high-placed forward lobe and scaphoid outline; also var. *scotica**, Jones and Hall, and other varieties*.

*B. impar**, spec. nov. [fig. 23*k*].—With a narrow, curved, median lobe, separated on one side by a widely-ovate sulcus from the curved lobe-like swelling, and on the other side by a shallow furrow from a conspicuous round tubercle on the convex moiety of the valve.

Ulrichia, sp*.

*U. girvanensis**, spec. nov. [fig. 23*p*].—Neatly sub-oblong, straight on the upper, elliptic on the lower edge, with a pair of small tubercles high up on the medio-dorsal region.

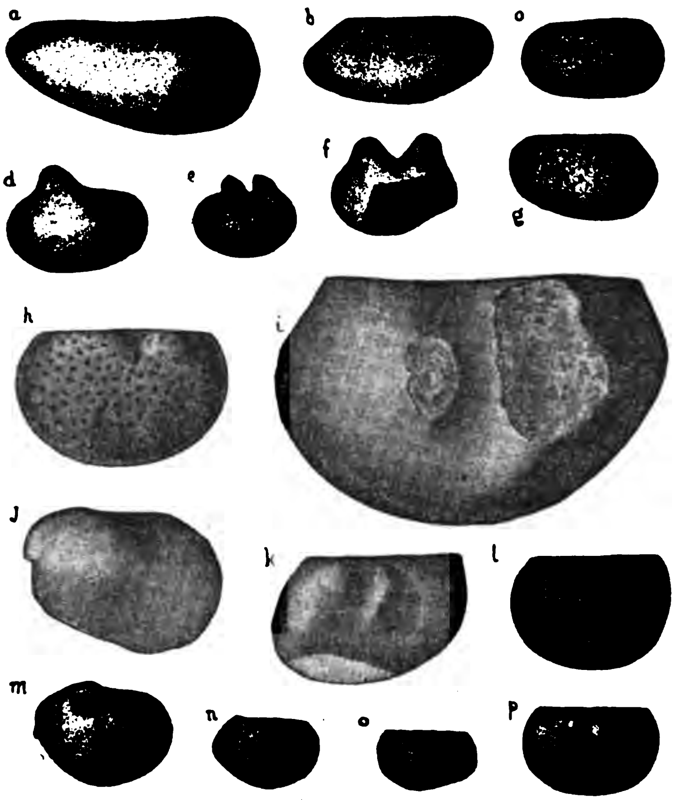


FIG. 23*a*.—*Aparchites subovatus.*
,, *b.*—————— *subtruncatus.*
,, *c.*—*Cytherella subparallela.*
,, *d.*—*Æchmina obtusa.*

FIG. 23*e*.—*Ulrichia Marrii.*
,, *f.*—————— *Nicholsoni.*
,, *g.*—*Aparchites leperditioides.*

All from Westmoreland. × 25 diam.

FIG 23*h*.—*Primitia girvanensis.*
,, *i.*—*Ulrichia Grayæ.*
,, *j.*—*Cypridina Grayæ.*
,, *k.*—*Beyrichia impar.*
,, *l.*—*Primitia Ulrichiana.*

FIG. 23*m*.—*Sulcuna præcurrens.*
,, *n.*—*Primitia Grayæ.*
,, *o.*—————— *Krausei.*
,, *p.*—*Ulrichia girvanensis.*

All from Girvan. × 25 diam.

*U. Grayæ**, spec. nov. [fig. 23*i*].—Large, bean-shaped, with well-defined dorsal angles, with a deep and strong sulcus and two strong tubercles.

*Sulcuna præcurrens**, spec. nov. [fig. 23*m*], with a projecting dorsal knob, so that the dorsal margin is bare and deeply notched.

*Cypridina Grayæ**, spec. nov. [fig. 23*j*].—The shape is nearly that of the Carboniferous *C. Youngiana*, but boldly rounded in front.

***406. Jones, T. R.—On some Palæozoic Ostracoda from Westmoreland.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 288–295, plate xii.

After an indication of previous writings on the subject, the author describes:—

*Primitia centralis**, Ulrich, *P. mundula*, Jones, and var. *longa*, nov., longer, and var. *producta*, nov., still longer. Pasgill.

*Aparchites subovatus**, spec. nov. [fig. 23*a*].—Like *Primitia minuta*, but without any dorsal furrow. Dufton.

*A. subtruncatus**, spec. nov. [fig. 23*b*].—More evenly curved below, and with a postero-dorsal slope. Pasgill.

*A. leperditioides**, spec. nov. [fig. 23*g*].—Has the outline of a *Leperditia* and a punctate surface. Pasgill.

*Cytherella subparallela**, spec. nov. [fig. 23*c*].—Differs from *C. parallela* by not being punctate, and having a relatively smaller posterior half. Dufton and Pasgill.

*Ulrichia Nicholsoni**, spec. nov. [fig. 23*f*].—The pair of knobs occupy all the dorsal region, with their broad short elevations divided by a wide triangular opening. Pasgill.

*U. Marrii**, spec. nov. [fig. 23*e*].—The knobs from two obliquely subcylindrical, hornlike processes rising from the interior (?) half pointing backwards, and with a narrow space between them. Dufton.

*Æchmina obtusa**, spec nov. [fig. 23*d*].—Nearly semicircular on the ventral border, the valves protrude dorsally, in a thick blunt process, involving so much of the hinge-line as to give a subtriangular outline to the valve. Pasgill.

407. Young, J.—Notes on the group of Carboniferous Ostracoda found in the Strata of Western Scotland, with a Revised List of Genera and Species.

Trans. Geol. Soc. Glasgow, vol. ix. pp. 301–312.

A general account is given of the history of the discovery and description of these organisms, with notes on the several genera represented and a bibliography. A complete list is then given of all described forms, viz. 29 from the Calciferous Sandstone series, 80 from the Lower Limestone series, 4 from

the Lower Coal and Ironstone series, 42 from the Upper Limestone series, and 6 from the Upper Coal and Ironstone series.

***408. Chapman, J., and Sherborn, C. D.—On the Ostracoda of the Gault at Folkestone.**

Geol. Mag., Dec. 3, vol. x. pp. 345–349.

The following 39 species are recorded in zones 1 . . . . 11. Those in italics have not been found by the authors.

Paracypris *gracilis*, Bosq.
——— siliqua, J. and H.
Pontocypris trigonalis, J. and H.
——— triquetra, Jones.
——— Bosquetiana, J. and H.
——— attenuata, Reuss.
Bairdia subdeltoidea, Munst.
——— Harrisiana, Jones.
Macrocypris *Munsteriana*, J. and H.
Bythocypris *Reussiana*, J. and H.
——— silicula, Jones.
Cythere Harrisiana, Jones.
——— lineatopunctata, C. and S.
——— gaultina, Jones.
——— Koninckiana, Bosq.
——— spirifera, C. and S.
Cythereis triplicata, Röm.
——— auriculata, Corn.
——— quadrilatera, Röm.
——— ornatissima, Reuss.
Cythereis excavata, C. and S.
——— Wrightii, J. and H.
——— Lonsdaleana, Jones.
——— rudispinata, C. and S.
——— vallata, Jones.
Cytheridea perforata, Röm.
——— rotundata, C. and S.
Pseudocythere simplex, J. and H.
Cytherura *appendiculata*, Jones.
Cytheropteron concentricum, Reuss.
——— alatum, Bosq.
——— umbonatum, Will.
——— Sherborni, J. and H.
——— folkestoniensis, C. and S.
Cytherella ovata, Röm.
——— Münsteri, Röm.
——— subreniformis, J. and H.
——— Williamsoniana, Jones.
——— *Beyrichi*, Reuss.
Polycope, sp.

The following are the new species:—

*Cythere ? spirifera**, spec. nov. [fig. 24*g*].—Carapace smooth, strongly arched on the dorsal, straight on the ventral side, with a projecting spine on the ventral margin at the hinder end. Hinge-line a simple flange.

*C. lineatopunctata**, spec. nov. [fig. 24*c*].—Carapace much swollen at the ventral margin and overhanging, with coarse square punctations in somewhat parallel lines; a central ridge, not strongly developed, runs down the length of the shell.

Cythereis triplicata, Röm., var. *lineata**, nov. — Each of the lobes or ridges are delicately ornamented with three or four longitudinal raised striæ.

*C. rudispinata** spec. nov. [fig. 24*e*, *f*].—Carapace with three parallel ridges of curious spines, spreading and flat at the apex and, in some, mushroom-shaped.

*C. excavata**, spec. nov. [fig. 24*b*].—Subquadrate with an irregular front, just below which is a fenestrated much-raised ridge. Surface coarsely reticulate, rising up towards the hinder end, standing away from the true margins, and terminating in a sharply defined edge near the end.

C. Wrightii, J. and H., var. *aculeata**, nov.—The rounded processes produced into spines and prickles. Front edge very thin, hinder end produced into a long spike, and the margin there strongly aculeate.

*Cytheridea rotundata**, spec. nov. [fig. 24*a*].—Valve subspherical, with very coarse punctations showing as pimples on the inner surface. Hinge-line a bar with a pitted socket at each end.

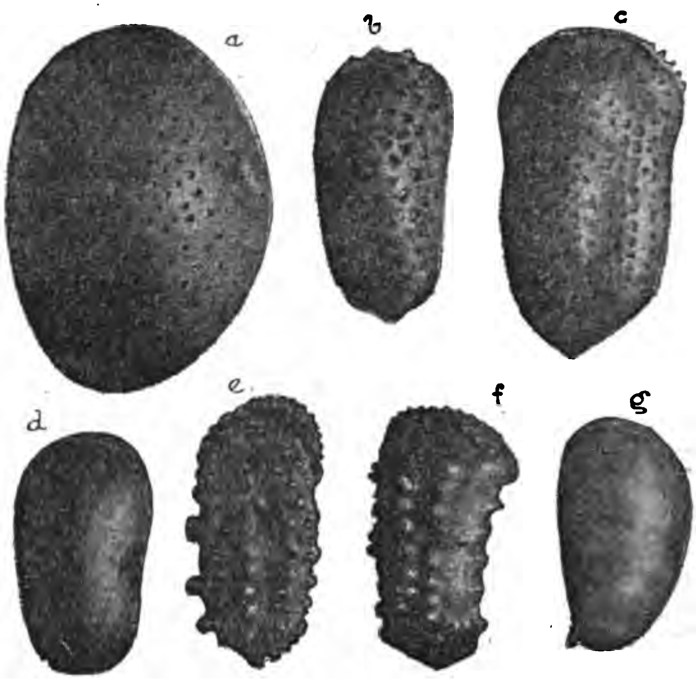


FIG. 24.—Entomostraca from the Gault of Folkestone: × 50. *a. Cytheridia rotundata. b. Cythereis excavata. c. Cythere lineatopunctata. d. Cytheropteron folkestoniensis. e. Cythereis rudispinata*, right valve. *f. Cythereis rudispinata*, left valve. *g. Cythere? spirifera.*

*Cytheropteron folkestoniensis**, spec. nov. [fig. 24*d*].—Valve oblong, with the mid-dorsal sulcus well marked; central area tolerably flat, slopes steep. There is also a dorsal flange. The posterior portion of the valve higher than the anterior. Surface polished.

***409. Jones, T. R., and Woodward, H.—On some Palæozoic Phyllopodous and other Fossils.**

Geol. Mag., Dec. 3, vol. x. pp. 198–203, plate x.

The fossils here described are:—

*Peltocaris Salteriana**, spec. nov. — Surface ornament of strongly marked concentric oblique striæ, wider apart on the left valve. Lower Tremadoc, Moel Llyfnant.

Conularia fragment; *Dipterocaris Etheridgei*, T. R. J. and H. W.—Upper Silurian, Penyglog; Mytiloid shells; fragments of a Phyllocarid.

*Aptychopsis Williamsi**, spec. nov.—Differs from *A. ovata* and *A. Wilsoni* in the curve of the outer edge, and in the proportion and angle of the nuchal notch. Upper Silurian, Welshpool.

Ceratiocaris insperata, Salter, Arenig, Llechwedd Deiliog, and Upper Tremadoc, Penmorfa: a "subtrigonal, probably Crustacean test." Upper Silurian, Leintwardine.

410. Jones, T. R.—Ninth Report of the Committee . . . on the Fossil Phyllopoda of the Palæozoic Rocks.

Rep. Brit. Assoc. for 1892, pp. 298–300.

Published in 1892 in the Geological Magazine [*see* No. **307**, 1892].

ASTEROIDEA.

***411. Sladen, W. P.—A Monograph on the British Fossil Echinodermata from the Cretaceous Formations. Vol. ii.: The Asteroidea (part ii. pp. 29–66, plates ix.–xvi.).**

Pal. Soc. for 1893.

This part concludes the description of *Pentagonaster megaloplax*, and then comes:—

Metopaster, gen. nov. — Depressed, pentagonal, marginal plates with uniform punctations, and surrounded by a narrow, depressed, and minutely punctated border. Supero-marginal plates few, the largest being the ultimate paired ones. Abactinal and actinal areas with polygonal granulated plates. Inferomarginal plates more numerous, decreasing in size towards the end of the ray. The forms to be referred to this genus have hitherto been included in *Goniodiscus*.

*M. Parkinsoni** (Forbes), Upper Chalk—An odd terminal or "ocular" plate is here figured, with other parts. *G. rectilineus*, M'Coy, is a synonym.

*M. Mantelli** (Forbes), Upper Chalk; *M. uncatus** (Forbes), Upper Chalk.

*M. Bowerbanki** (Forbes), Upper Chalk.

*M. zonatus**, spec. nov.—Abactinal surface concave by the upturning of the rays, sides distinctly lunate, margin thick; supero-marginal plates eight from ray to ray, three times as broad as long; ultimate paired plates twice the length of the others; infero-marginal plates fourteen from tip to tip. Otherwise near *M. Parkinsoni*. U. C.

"*M. sublunatus* (Forbes)."—Nothing corresponding to this name can be found, and the author suggests that the specimens in Jermyn St. Museum thus labelled, are actinal surfaces of *M. uncatus*, which, being taken for abactinal surfaces, have been considered to belong to another species.

*M. cingulatus**, spec. nov.—Small, sides slightly lunate, margin thick, supero-marginal plates six from tip to tip, breadth two-and-half times the length; their surface is tumid, almost tuberculous in the middle third, and ornamented by large irregular granules; height as seen from the margin greater than the length. The ultimate paired plates are triangular. In other respects comparable with *M. uncatus*. U. C.

*M. cornutus**, spec. nov.—Described from drawings prepared for Dr. Wright, the specimen itself not being discoverable: small, ends of rays slightly produced; supero-marginal plates four from tip to tip, those next the interradial line small, surrounded by a very narrow, depressed, minutely punctate border; the ultimate paired plates much larger, elytron-shaped; at one-fourth from the distal end projects a beak-like prominence; infero-marginal plates large and high.

Mitraster, gen. nov.—Cycloidal in contour; marginal plates with a depressed punctated border for setæ; supero-marginal plates few and subequal, otherwise comparable with *Pentagonaster* and *Metopaster*.

*Mitraster Hunteri** (Forbes), U. C. *M. rugatus** (Forbes), U. C. (description unfinished).

CORALS.

412. Thompson, Jas.—On the genera** ***Calophyllum **and** ***Campophyllum*****.**

Proc. Roy. Irish Acad., 3rd series, vol. ii., No. 5, p. 667, etc., plates xv., xxi.

Where transverse sections are made across the calyx, "the different species of *Calophyllum* are found to possess minute secondary septa; there are no interseptal dissepiments in the peripheral zone, and the tabulæ extrude to the wall; while in all the species of *Campophyllum*, there are both primary and secondary septa, interseptal dissepiments are more or less developed, and the tabulæ never reach the wall." "*Campophyllum* proper presents an intermediate group, separated on the one side from *Calophyllum* by the presence of a zone of vesicular tissue round the periphery, and by the tabulæ never reaching the wall, and on the other side from *Cyathophyllum* by the circumscribed extension of the septa and the correspondingly enlarged tabulate area. Sections have also shown an alternation of the mode of reproduction, which is sometimes by ova and sometimes by gemmation or fission. The structural details

which seem so distinct in the isolated adult are found to merge into each other in the young, or when a large series is examined. This statement is illustrated by a series of eight sections taken from different parts of the same corallum of *Campophyllum cylindricum*, which show such changes, and particularly how in youth some of the septa are extra stout, whereas they all become equal in the adult. A similar series is figured in *C. asheyburnense*. Notes are also given of corals which break off below along the surface of a tabula, and so appear concave. The author states that the characters of the fossula which have been relied on to separate genera are not reliable, and, if used, their number would be vastly increased. Thus, the genus *Crepidophyllum* has been established for forms in which the septa which bound the fossula are joined by a semicircular plate, which plate is nothing more than an oblique section of a convex tabula.

The species from the Lower Carboniferous are then described. They are all new, except those followed by a name, and in the list here given the names assigned have been corrected, *e.g.* simplex for "simplicum." The species are all represented by transverse sections only, which are printed direct from nature:—

Calophyllum Danai.
——— spinosum.
——— tuberculatum.
——— irregulare.
——— Le Honeanum, De Kon.
——— cuspidatum.
——— nodosum.
——— angulare.
——— denticulatum.
——— robustum.
——— approximatum.
Campophyllum Murchisoni, E. and H.
——— brockleyense.
——— simplex.
——— cylindricum, Scouler.
——— gigantium, Mechelin.
——— decuspidophyllum, Thompson.
——— recurvatum.
——— breviseptum.
——— subfurcillatum.
——— Juddi.
——— laxum, Thompson.
——— dissimile.
——— alteroseptum.
——— furcatum.
——— rectangulare.
Campophyllum dendroide.
——— amplexum.
——— subclaviforme.
——— mammillatum.
——— hyperphyllum.
——— turbinatum.
——— concavum.
——— marginatum.
——— interruptum.
——— echinatum, Thompson.
——— asheyburnense.
——— submammillatum.
——— radiolare.
——— dendroide (bis).
——— elegans.
——— Agassizi.
——— domiforme.
——— tuberculatum.
——— subpalmatum.
——— radiolare (bis).
——— Taylori.
——— intercellulosum.
——— subclavatum.
——— crenulatum.
——— clavatum.
——— fasciculatum.

413. Tomes, R. F.—Observations on the Affinities of the genus *Astrocœnia*.

Quart. Journ. Geol. Soc., vol. xlix. pp. 569–573, plate xx.

The author quotes the original description of the genus *Astrocœnia* given by Milne Edwards and Jules Haime, and shows that they have included under the same name species which had circular and not polygonal corallites, and some with and some without any cœnenchyma. The author has also examined some Cretaceous forms which have been referred to this genus by Reuss and Bölsche, and he finds that the walls of the corallites in these "are thin and rudimentary," whereas the founders of the genus said the corallite walls in that genus were thick. In the specimens referred to the corallites are partially filled up internally by stereoplasm, which make the walls *look* thick and the calices circular. The author proposes to use the name *Astrocœnia* for these Cretaceous forms only, and gives a new definition embodying the above observations.

414. Tomes, R. F.—Description of a new Genus of Madreporaria from the Sutton Stone of South Wales.

Quart. Journ. Geol. Soc., vol. xlix. pp. 574–577, plate xx.

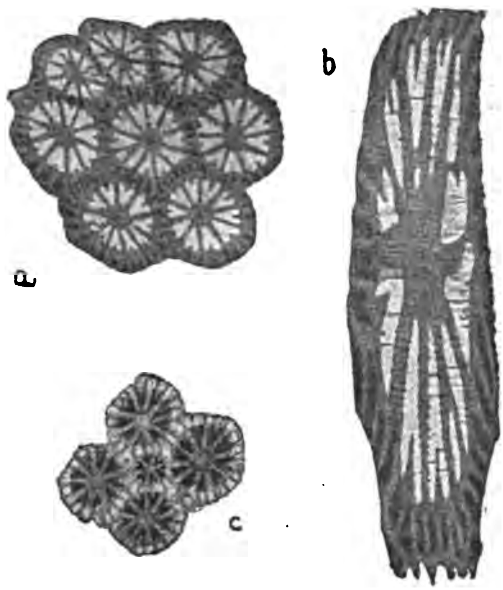


FIG. 25.—*Stelidioseris gibbosa.*
From the Sutton Stone.

a. Transverse section × 4.
b. Oblique section × 6.
c. Upper surface showing gemmiparous calyx × 4.

The specimen described by P. M. Duncan (Q. J. G. S., vol. xlii.) as *Astrocœnia gibbosa*, has been compared with other specimens referred to that species, and is considered to be distinct from them. A slice from the bottom of the specimen has been prepared, and this is said to show characters which separate it from the genus *Astrocœnia* and place it near *Clausastræa*. There are, it is said, no thick, nor indeed any walls, but the septa of one calyx are continuous with those of another. The so-called ornamentation of the sides of the septa is resolved into pseudo-synapticulæ, and the mode of increase is shown to have been both by fissiparity and by extra-calicular gemmation. The septa and their connecting costæ consist of a single trabecula. There are a few weak and straight true synapticulæ. These characters are considered to indicate a new genus called *Stelidioseris*, and the species is called *S. gibbosa**, spec. nov. [fig. 25].

GRAPTOLITES.

*415. Sollas, W. J.—On the Minute Structure of the Skeleton of *Monograptus priodon*.

Geol. Mag., Dec. 3, vol. x. p. 551. (Read at Brit. Assoc.)

The specimens examined are from Barnham Hill, co. Tipperary. Cross-sections show the black carbonaceous wall to be composed of three layers, the outer and inner ones being very thin, the middle one thicker, now composed of calcite. The virgula appears to possess no independent existence, but to be merely a thickening of the middle layer.

SPONGES.

*416. Hinde, G. J.—A Monograph of the British Fossil Sponges. Part iii. Sponges of the Jurassic Strata, pp. 189-254, plates x.-xix.

Pal. Soc. for 1893.

The following is the distribution of sponges in the British Jurassic rocks:—

	Siliceous Sponges.	Calcisponges.
Purbeck beds	1	0
Portland beds	2	0
Corallian	1	7
Great Oolite	0	14
Inferior Oolite	15	19
Lias	2	1

Very few species are recognized as passing from one formation to another of the siliceous forms; only one, *Pachastrella antiqua*, occurs in two, *i.e.* in the Lower Lias and in the Portland.

Four calcisponges are common to the Great and Inferior Oolites, and one to the Great Oolite and Corallian. Hexactinellid sponges have been found only in the Inferior Oolite. The total number of British Jurassic Sponges is 56, and the characteristic feature of them is the abundance of the calcisponges, which lived alongside of and often attached to the siliceous ones. The following are the species:—

HEXACTINELLIDÆ—DICTYONINA.

*Tremadictyon sparsum**, spec. nov.—Open, cup-shaped, ostia of the surface oval, 1½mm. × 3mm., spicular mesh lax and irregular, bounding very unequal interspaces. *Parkinsoni* zone.

*T. incertum**, spec. nov.—Cup-shaped with thick walls, ostia of the surface oval, 2mm. × 4mm., spicular mesh very irregular and open. *Parkinsoni* zone.

*Callathiscus variolatus**, Sollas, *Parkinsoni* zone; *Craticularia clathrata** (Goldf.), *Parkinsoni* zone; *C. foliata** (Quenst.), *Parkinsoni* zone; *Verrucocœlia Whidbornei** (Sollas), the type of Sollas' genus *Mastodictyum*, which the author thinks should not be separated, *Parkinsoni* zone; *V. elegans** (Sollas), the type of Sollas' genus *Plectospyris*, *Parkinsoni* zone; *V. major** (Sollas), *Parkinsoni* zone.

*Stauroderma explanatum**, spec. nov.—Flattened, plate-like fragments, upper surface smooth, ostia nearly circular, 4mm. diam., arranged quincuncially at 10mm. distance, spicular mesh very irregular, dermal layer, 1 mm. thick, of cruciform spicules. *Parkinsoni* zone.

LITHISTIDÆ—RHIZOMORINA.

*Platychonia Brodiæi**, Sollas, Middle Lias; *P. elegans**, Sollas. *Parkinsoni* zone.

*P. tenuis**, spec. nov.—Differs from *P. elegans* in its thinner walls, more even surfaces, and more delicate spicules. *Parkinsoni* zone.

*P. affinis**, spec. nov.—Characterized by its platter-shaped form, its inversely conical base, and the more distinctly fibrous character of its spicular mesh. *Parkinsoni* zone.

*Leiodorella contorta**, spec. nov.—Has a fan-shaped expansion; the under surface shows a smooth dermal layer, with numerous irregularly placed oscules, not now projecting above the surface. *Parkinsoni* zone.

L.—ANOMOCLADINA.

*Melonella ovata** (Sollas), considered by Sollas to be hexactinellid, and made to be the type of the genus *Taxoploca*, but "there can be no doubt that its spicular structure is really of the *Anomocladina* type." *Humphriesianus* zone.

TETRACTINELLIDÆ.

*Pachastrella antiqua**, Moore. Lower Lias and Portland.

Geodites, sp. *a**, Portland; *Geodites*, sp. *b*, *Parkinsoni* zone; *Rhaxella perforata**, Hinde. Corallian.

MONACTINELLIDÆ.

*Spongilla purbeckensis**, Young. Purbeck.

CALCISPONGIA—PHARETRONES.

*Peronidella pistilliformis** (Lamx.). Great Oolite, Forest Marble and Cornbrash; *P. tenuis**, Hinde. *Murchisonæ* zone; *P. metabronnii**, Sollas. *Parkinsoni* zone; *P. nana**, Hinde. *Parkinsoni* zone, and in Richmond boring.

*P. Waltoni**, spec. nov.—Forms colonies of subcylindrical stems, with short lateral branches, walls thick, cloacal tube extending throughout the length, outer surface smooth, with small circular apertures of cloacal tube indefinitely arranged; the central fibres of the wall are the thinnest, and the stouter fibres have a marginal layer of filiform spicules. Great Oolite.

*P. recta**, spec. nov.—Either single, or consisting of two to four cylindrical pipes growing on a thickened base; outer surface smooth, with closely arranged fibres. *Perarmatus* zone.

*Eusiphonella prolifera**, spec. nov.—In large, frequently branching, masses radiating from a centre; individuals with swollen summits flat above where the branching occurs; outer surface with minute ostia; interior of cloacal tube with horizontal projections and intervening elongate ostia; spicular fibres delicate and mostly three-rayed. Great Oolite.

*Corynella lycoperdioides** (Lamx.). — Bradford Clay and Cornbrash.

*C. elegans**, spec. nov.—Simple or compound, individuals round with short stem; when compound, sessile on a common base and large surface; with small ostia and irregular apertures between the fibres, rim of oscule not projecting, cloacal tube with many elongate apertures, fibre forming an open mesh. Great Oolite.

*C. punctata**, spec. nov.—Similar to the last, but the surface, when not covered by the dermal layer, is dotted over by ostial apertures of very irregular form, sometimes elongate, or substellate, bounded by a very delicate spicular mesh. *Murchisonæ* zone.

*C. langtonensis**, spec. nov.—Short, subcylindrical, attached; from the rim of the oscular aperture open furrows extend down the sides; outer surface with irregular ostia. *Plicatilis* zone.

*C. Chadwicki**, spec. nov.—Subcylindrical, oscule circular, entire or furrowed, cloacal tube extending to near the base, with wide canals opening into it; outer surface a delicate meshwork of fibres with intervening apertures; no definite ostia; large three-rayed spicules in the centre of the fibre, enclosed in sinuous filiform spicules. *Plicatilis* zone.

*C. cribrata**, spec. nov. — In colonies, amalgamated or divergent; dermal layer only on basal portion, summits inflated or conical, margin entire or furrowed, walls deeply traversed by

anastomosing canals opening into the cloacal tube, skeletal fibres delicate, three-rayed, one ray short. Great Oolite.

Holcospongia, gen. nov.—Proposed for those Jurassic and Cretaceous sponges which have been hitherto placed in *Stellispongia*; the type of the latter, however, has short, blunted, sinuous spicules, instead of three or four-rayed ones; the form and canal structure, however, are the same. *Enaulospongia*, From., is also included, but as it was described as without canals the name is not adopted.

*Holcospongia floriceps** (Phillips), *Perarmatus* zone; *H. glomerata* (Quenst.), *Plicatilis* zone; *H. liassica* (Quenst.), *Parkinsoni* zone.

*H. polita**, nom. nov. for *Stellispongia corallina*, Hinde, part, viz. Brit. Foss. Sponges, plate xxxv. fig. 3*a*. — Differs from *H. floriceps* by its smaller size, subspherical form, and more delicate fibres.

*H. sulcata**, spec. nov.—Simple, fan-shaped, dermal layer on the base only; on the upper surface open grooves radiate from a central area, in which are one or two oscules; they bifurcate, but seldom reach the margin. On the lower surface there are similar canals radiating from the pedicle, but not joining the upper ones. *Parkinsoni* zone.

*H. contorta**, spec. nov.—Spherical or club-shaped, with a flattened or corrugated base, the front and summit with five or six radiating furrows bounded by thickened ridges; other irregular furrows elsewhere, mostly covered with a rugose dermal layer with large three-rayed spicules; about the size of a pea. *Parkinsoni* zone.

*H. bella**, spec. nov. — Small, simple, discoidal, base flattened, with a rugose dermal layer forming a saucer; upper surface with radiating ridges, each having a row of canal apertures, with intervening grooves. *Parkinsoni* zone.

*H. mitrata**, spec. nov.—Small, simple, base flattened, with a rugose dermal layer, summit like a mitre, with 3–5 open radiating grooves into which canals open, intervening surface with circular ostia. *Parkinsoni* zone.

*Myrmecium biretiforme**, Sollas. *Parkinsoni* zone.

Lymnorella emend., Hinde, *Lymnorea*, Lamx., being preoccupied; *L. mammillosa**, Lamx., *Murchisonæ* zone; *L. inclusa** (Hinde), [*Inobolia*, Cat. Foss. Sponges, appears to be withdrawn as a genus], Pea-grit series; *L. pygmæa**, Sollas, Pea-grit, *Parkinsoni* zone and Great Oolite; *L. micula**, Great Oolite.

*L. ramosa**, spec. nov.—Bushy masses of compressed solid branches, springing from a thickened basal stock; branches dichotomizing, without oscules or axial canals; surface with small apertures, and here and there a rosette-like group of larger ones; fibres with three-rayed spicules in single central series, surrounded by crystals now. Pea-grit.

*Oculospongia minuta**, Hinde. *Parkinsoni* zone and from the Richmond boring.

*Eudea Walfordi**, spec. nov.—Small, simple, subglobular, attached summits with subcentral oscule, outer surface covered with a dermal layer except for the characteristic apertures, with slightly elevated margins, skeletal fibres short. *Parkinsoni* zone.

*E. pisum** (Quenst.), conical with tubular apertures. *Parkinsoni* zone.

*Elasmostoma palmatum**, spec. nov. — Fan or ear-shaped plates, attached by the margin; dermal layer on one surface compact, with numerous large oscules with elevated margins on the other; non-oscular surface; with interspaces between fibres only; dermal layer of felted three-rayed spicules. Great Oolite and Forest Marble.

*Diaplectia auricula**, Hinde. Pea-grit.

*D. infundibulum**, spec. nov. —Funnel-shaped, inner and outer surface smooth, no dermal layer or canal system. Great Oolite.

*Blastinia costata** (Goldfuss). Inferior Oolite Marl, and Richmond boring.

*B. aspera**, spec. nov.—Simple or compound, shape various, dermal layer on base only, ridges sharp with lateral corrugations uniting at the summit, exterior fibres delicate, simple in a single series, inner one thicker. *Perarmatus* zone.

LEUCONES.

*Leucandra Waltoni**, Hinde. *Spinatus* zone.

FORAMINIFERA.

417. Young, J.—Notes on a small group of Carboniferous Foraminifera found in the Lower Limestone Shales of the Muirkirk district in Ayrshire, with a list of the Genera and Species found in the Coal-fields of Western Scotland.

Trans. Geol. Soc. Glasgow, vol. ix. pp. 313–319.

Draws attention to the advantage of studying Foraminifera in their sections, as well as isolated. The two most prolific localities for Carboniferous forms are Durnchurch Quarry and Ashawburn, Muirkirk, especially the latter. *Girvanella* also is noticed, and it is suggested that this may be an uncoiled form of *Trochammina*. There is also an abundance of a little spherical form, occasionally clustering together, which may belong to *Globigerina*. The list given is that of Brady's monograph. Nineteen of the species occur at Muirkirk.

*418. Chapman, F.—The Foraminifera of the Gault of Folkestone: IV.

Journ. Roy. Micr. Soc. for 1893, pp. 579–595, plates viii., ix.

The species here described and figured are (the figures signify the zones of the Gault in which they occur):—

FIG. 26.—Foraminifera from the Gault.
a. Nodosaria bambusa × 50
b. ——— perpusilla × 75
c. Dentalina raristriata × 60
d. Nodosaria intercostata × 60

Lagena globosa (Mont.), 8, 11.
——— apiculata, Reuss, most.
——— lævis (Mont), 4, 5, 11.
——— gracillima (Seg.), 11.
——— aspera, Reuss, 3, 11.
——— hispida, Reuss, most.
——— sulcata (W. and J.), 2, 4.
——— acuticosta, Reuss, 5.
——— gracilis, Will., 2, 3, 11.
——— alifera, Reuss, 9.
Lagena striatopunctata, P. and J., 4, 11.
——— marginata, W. and B., 11.
——— quinquilatera, Brady, 2.
Nodosaria humilis, Römer, 5, 10, 11.
——— mutabilis, Reuss, 3, 6, 11.
——— cylindracea, Reuss, 11.
——— radicula (L.), 9, 11.
——— oligostegia, Reuss, 7, 11.
——— hispida, D'Orb., 1, 4, 5, 7, 11.

Nodosaria perpusilla, spec. nov., 3, 5, 11.	Dentalina cylindroides, Reuss, 5, 10, 11.
——— bambusa, spec. nov., 5, 11.	——— hamulifera, Reuss, 11.
——— sceptrum, Reuss, 1.	——— sciphioides, Reuss, 5.
——— internotata, spec. nov., 1, 3, 5, 11.	——— legumen, Reuss, 7, 11.
——— inflata, Reuss, 5, 9, 11.	——— Römeri, Neugboren, 1, 4, 7, 10, 11.
——— tenuicosta, Reuss, most.	——— communis, D'Orb., 3, 5, 7, 9, 11.
——— prismatica, Reuss, most.	——— mucronata, Neugb., 5, 10, 11.
——— orthopleura, Reuss, most.	——— costellata, Reuss, 11.
——— tetragona, Reuss, 4, 7, 10, 11.	——— raristriata, spec. nov., 11.
Dentalina expansa, Reuss, 3, 11.	——— intercellularis, Brady, 3, 11.
——— farcimen (Gold.), 8, 10, 11.	——— tubifera, Reuss, most.
——— soluta, Reuss, 1, 2, 8, 9, 10, 11.	——— Zippei, Reuss, 5, 7, 9, 10, 11.
——— gracilis, D'Orb., most.	——— paupercula, Reuss, most.
——— Lorneiana, D'Orb., 3, 11.	——— Fontannesi, Berthelin, most.
——— pauperata, D'Orb., 3, 4, 7, 11.	——— obscura, Reuss, most.
——— consobrina, D'Orb., 3, 5, 8, 11.	

The new species are:—

*Dentalina raristriata**, spec. nov. [fig. 26*c*].—Filiform of 10 or more segments tapering to a sharp point, surface with three or four interrupted and fine costæ.

*Nodosaria perpusilla**, spec. nov. [fig. 26*b*].—Small, of seven chambers, each of length equal to breadth, sutures distinctly marked, aboral end mucronate, with six or seven delicate costæ.

*N. bambusa**, spec. nov. [fig. 26*a*].—Subcylindrical, with slightly inflated segments, the divisions only seen as translucent, sub-surface markings, costæ fine, numerous, twisted, large.

*N. internotata**, spec. nov. [fig. 26*d*].—Of five more or less inflated chambers, the last much larger than the others, costæ delicate, with interrupted costulæ.

In part iii. p. 750, line 12, for *annectens* read *complanata.*

RADIOLARIA.

*419. Hinde, G. J.—Note on the Radiolaria in the Mullion Island Chert.

Quart. Journ. Geol. Soc., vol. xlix. pp. 215–218, plate iv.

The weathered surface of the chert shows the lattice structure of the tests, which have the aspect of, but are much smaller than, millet seeds; otherwise the only way of observing them is by making thin slices of the rock, and they can therefore be only approximately determined, and are previously named.

Sub-order SPHEROIDEA.

Cænosphæra, sp.* [fig. 27*a*]. — Spherical, showing lattice structure on the surface, size up to ·3 mm. They most resemble *C. gregaria*, Rüst.

Carposphæra, sp. *a** [fig. 27*b*]. — With two tests, the outer one ·145 mm., the inner one ·045 mm. in diameter. Three rays connect the tests. They most resemble *C. pygmæa*, Rüst.

C., sp. *b** [fig. 27*c*].—Outer test ·095 mm., inner one ·03 mm. in diameter, tests with seven or eight connecting rays.

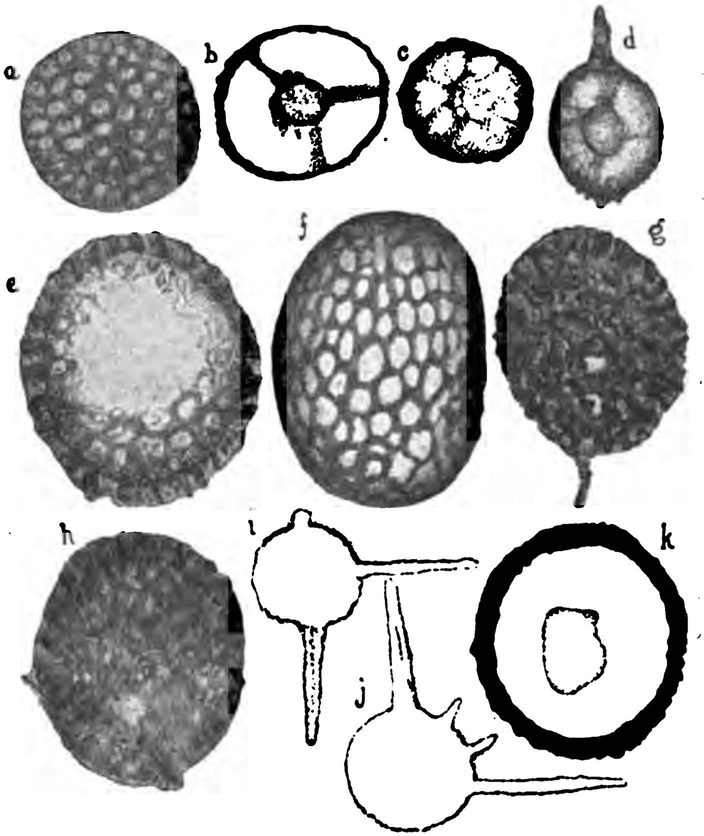


FIG. 27.—Radiolaria from Mullion Island Chert.

a. Cænosphæra,	sp.	× 166		*g. Lithapium*,	sp.	× 166
b. Carposphæra,	sp. *a*.	× 166		*h. Cenellipsis*,	sp. *b*.	× 166
c. ———	sp. *b*.	× 166		*i.* } *j.* }	Forms undetermined	× 83
d. Lithatractus,	sp.	× 166				
e. Cenellipsis,	sp. *a*.	× 166		*k. Cenellipsis*,	sp. *b*.	× 166
f. ———	sp. *c*.	× 166				

Sub-order PRUNOIDEA, with oval tests.

Cenellipsis, sp. *a** [fig. 27*e*]. — Diameters ·220 mm. and ·185 mm., surface apparently smooth, lattice work narrower than the holes.

C., sp. *b** [fig. 27*k*]. — Diameters ·2 mm. and ·165 mm., wall thinner.

C., sp. *c** [fig. 27*f*].—Diameters ·25 mm. and ·18 mm. The apertures are circular and oval, larger than the lattice work. Resemble *C. perovalis*, Rüst, but the apertures are smaller and less crowded.

Lithapium, sp.* [fig. 27*g*].—Diameters ·18 mm. and ·15 mm.; at one end, a conical spine ·045 mm. in length.

Lithatractus, sp.* [fig. 27*d*].—With two tests, the outer one ·110 mm. by ·085 mm., the inner one ·04 mm. in diameter, with four or five connecting rays, and one spine ·05 mm. in length; there are traces also of another on the opposite side, and of some small tubercles.

There are also two undetermined forms [figs. 27*i*, *j*], with circular outlines—one with three radial spines, of which the longest is ·195 mm.; the other with two spines about ·2 mm. long, and two short secondary spines.

PALÆOBOTANY.

420. Wilmore, A.—The Carbon Crust of Fossil Plants.

Geol. Mag., Dec. 3, vol. x. p. 576.

Asks three questions: 1. Why is the carbon only on the outside of the casts? 2. Does the crust represent all the carbon of the plant? 3. Why does it look so baked? No answers are attempted.

421. Carruthers, W.—Demonstration on Gymnosperms.

Proc. Geol. Assoc., vol. xiii. pp. 50–52.

No true *Cycadeæ* are found in Palæozoic rocks. The *Gnetaceæ* are only Tertiary, but Conifers commence in the Old Red Sandstone.

*422. Williamson, W. C.—The Organization of the Fossil Plants of the Coal-Measures, part xix.

Phil. Trans. B 80, vol. clxxxiv. pp. 1–38, plates i.–ix.

In *Lepidodendron Harcourtii*, it has not yet been shown that any secondary xylem was developed, such as has been met with in most other species of the genus, but we cannot, in the present state of our knowledge, assert that in this species it was absent at all ages, because we only know its internal structure up to a diameter of 3½ inches; and in the allied form, *L. Wunschianum*, which is preserved in volcanic ash in Arran,

there is also no secondary xylem in the smaller examples, but plenty in the larger stems. In the small stems of some *Lepidodendra*, now known to belong to *L. Harcourtii*, the central medulla is found in a very meristomic condition, so that it is probable that the diameter of the whole medulla will increase. The periphery of the primary tracheal cylinder which surrounds it has been called the corona by Prof. Bertrand, from which, in transverse sections, there are a number of vascular projections, with sections of leaf-traces in the bays. Beyond this is a zone of extremely delicate, thin-walled parenchyma, and then comes the cortex, consisting of two parts. The inner part is a thin zone of radially arranged prosenchymatous elements, which, in their developed condition, are elongated vertically, and are generated on the outside of the zone in a bark-cambrum. This prosenchymatous zone is found in all parts of the plant, including its stigmarian roots, but is not developed simultaneously throughout the entire circumference of the cortex. In longitudinal sections the medullary tracheids are seen to be transversely barred with vertical connecting threads. This zone has protuberances on the outside which are seen to correspond with those on the outside of the cortex. The outer part of the cortex is a thin layer of cells sporadically developed.

The organ which is seen near the base of the leaves, which Prof. Bertrand calls the ligule, is not thought by the author to be homologous with the organ so called in *Selaginella*, so he prefers to call it the adenoid organ.[1] In the leaf-traces between the vascular cylinder and the cortex, the phloem and xylem are seen to form, as the author believes, in spite of certain appearances, a collateral bundle. Where these bundles enter the prosenchymatous zone of the cortex there is found associated with each a rounded cluster of cells enclosed in a more or less distinct sheath, which Prof. Bertrand calls parichnos, and which becomes two-lobed and produces the marks seen on the stem surface by the side of each true leaf-scar. The leaves are now for the first time described: they were extremely short, quadrate in form, with a somewhat prominent apex. In structure they are parenchymatous, the cells becoming smaller and thicker-walled near the surface, while elongated cells pass upward in the direction of the apex, close to which the adenoid organ is seen.

It has already been shown that each of the tubercles on *Ulodendron* supported a strobilus, and that "*Haloniæ*" are the terminal divisions of Lepidodendroid branches. The arrangement of the tubercles on these two "genera" can now no longer be said to be distinct, as both kinds are found in one

[1] The author later on has become less inclined to reject Bertrand's opinion.

specimen, in which there are three contiguous vertical columns of true Ulodendroid scars, arranged in the quincuncial manner characteristic of *Halonia regularis*. From a comparison of two strobiles it is suggested that the true distinction is that in *Ulodendron*: the strobilus was on a very short, arrested lateral branch, so that it seemed to be sessile, and left its scar by pressure on the side of the stem, which is seen to be of the Lepidodendroid type, while in *Halonia* the strobilus was pedunculated, the base of the peduncles forming the tubercles.

The course of the tracheal bundles in the Halonial state of *L. Harcourtii* is then traced, and it is shown that they arise from the central tracheal bundle or primary xylem cylinder of the stem, that they have no medulla, and that they change in character, as traced outwards. The structure of the leaf in the *Lepidophloios* type, with its parichnos and adenoid organ, is well seen in transverse section, and the similarity of structure in these organs in *Sigillaria* and *Lepidodendron* speaks strongly for the close relationship of these two genera. Sections transverse to the tubercle of a Ulodendroid stem show tracheal bundles, showing that a deciduous organ, which can only be the strobilus, was attached to it. In the larger of these bundles medullary parenchymatous cells are seen in the centre.

The structure of the strobilus in *L. Spenceri* is then described. The sporangia lie in a single continuous layer, investing the vascular axis. Fine specimens, showing the heterosporous character of the *Lepidostrobus* of *L. brevifolium*, from Burntisland, are also figured. The *Lepidostrobus* described by Morris as *Lycopodites? longibracteatus*, from Coalbrookdale, was terminal at the end of a slender branch, and is here figured. A figure also is given of a homosporous *Lepidostrobus* from Oldham, in which the collateral bundles going to the sporangiopores are so similar to those going to the leaves that the organs containing them may be called sporophylles. This form is sufficiently distinct to require a name for reference, and it is accordingly called *Lepidostrobus Oldhamium*. Two other unnamed *Lepidostrobi* are finally figured.

***423. Williamson, W. C.—General, Morphological, and Histological Index to the Author's Collective Memoirs on the Fossil Plants of the Coal-Measures, part ii.** [For part i. *see* **375a**, 1891.]

Mem. and Proc. Manchester Lit. and Phil. Soc., vol. vii. pp. 91–127.

The author gives first a list of twenty-six of his papers; next he states that *Asterophyllites sphenophylloides* and *Bowmanites Dawsoni* must be included in *Sphenophyllum*, and that an independent family of *Sphenophyllidæ* must be recognized, references being given to the author's description of *S. Dawsoni*,

in which is included *Bowmanites Dawsoni* and *Volkmannia Dawsoni*. Next, in dealing with *Lepidodendron* he remarks that many of the names he has assigned are only intended for reference, and that it is uncertain how many of them will eventually be found to have specific value. He then gives details and references with regard to the types called *Lepidodendron selaginoides*, Sternb.; *L. brevifolium*, Will. (not Ett.); *L. fuliginosum*, Will.; *L. Wunschianum*, Will.; and *L. Harcourtii*, Will., all his references to which, made prior to 1887, must now be transferred to *L. fuliginosum*; *L. mundum*, Will.; *L. Spenceri*, Will., the axile primary tracheal strand of which shows four distinct types; *L. intermedium*, Will.; and *L. parvulum*, Will. Then come references to *Lepidophloios*, *Halonia*, *Ulodendron*, and *Lepidostrobi*. The essential differences between *Sigillaria* and *Lepidodendron* are those of external contour. Of the former there are three types, viz. the Favularian, that of *Rhytidolepis*, and that of *S. reniformis*, the last not having yet been figured or described. Finally references are given for *Stigmaria*.

424. Kidston, R.—On the Fossil Plants of the Kilmarnock, Galston, and Kilwinning Coal-fields, Ayrshire.

Trans. Roy. Soc. Edinburgh, vol. xxxvii. pp. 307–360, pls. i.-iv.

The following species, all of which, except *Sigillaria Walchii* from the upper part of the Lower Coal-measures, come from the lower part of the same, are here described or noticed:—

Calamitina varians, Sternb., and var *insignis*; *C. Göpperti* (Ett.); *C. verticillata** (L. and H.); *C. approximata**, Brongn.; *Calamites ramosus*, Artis; *C. Suckovii*, Brongn.; *C. undulatus*, Sternb.; *C. Cistii*, Brongn.; *Calamocladius equisetiformis* (Schloth.); *Annularia galeoides** (L. and H.); *Calamostachys typica*, Schimper; *Stachannularia ? northumbriana**, Kidston.

Urnatopteris tenella (Brongn.); *Eremopteris artemisiæfolia* (Sternb.); *Sphenopteris furcata*, Brongn.; *S. obtusifolia**, Brongn.; *S. latifolia*, Brongn.; *S. ? spinosa*, Göpp.; *S. Footneri*, Marratt; *S. Sternbergii* (Ett.); *Mariopteris muricata* (Schloth.); *Neuropteris heterophylla*, Brongn.; *N. gigantea*, Sternb.; *N. crenulata**, Brongn.; *N. Blissii**, Lamx.; *Odontopteris brittanica*, Gutbier; *Alethopteris lonchitica* (Schloth.); *A. decurrens* (Artis).

Spheriophyllum cuneifolium (Sternb.).

Lepidodendron ophiurus, Brongn.; *L. obovatum*, Sternb.; *L. aculeatum*, Sternb., and forma *modulatum*; *L. serpentigerum*, König.

*L. Landswigii**, spec. nov. [fig. 28*a*, *b*].—Stem large, with two opposite vertical rows of distant, large oval scars, umbilicus slightly below the centre; leaf-cushions variously spaced, rhomboidal, the apices twisted and prolonged into a keel, which connects them in a spiral series; leaf-scar large above the centre of the cushion, rhomboidal; lateral angles prominent

and produced into two ridges; from the upper and lower rounded angles also a ridge extends joining the keels of the leaf-cushions.

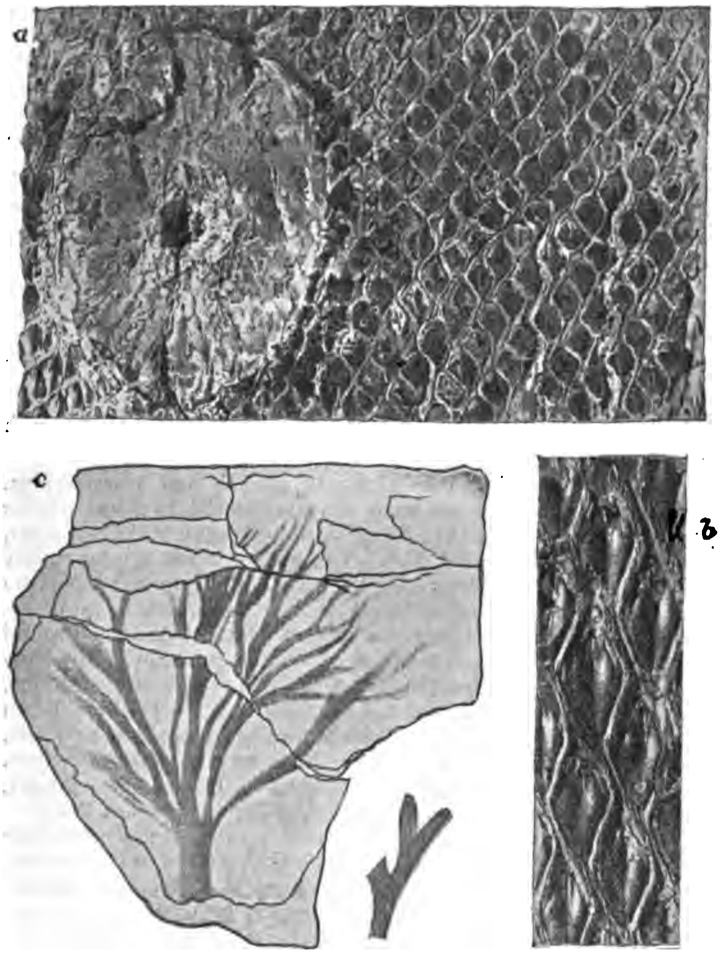


FIG. 28.—Coal-measure Plants.
a. Lepidodendron Landswigii.
b. Ditto, magnified.
c. Bythotreptus Worstonensis.

L. fusiforme, Corda; *Lepidostrobus variabilis*, L. and H.; *L. lanceolatus*, L. and H.; *L. spinosus**, Kidston; *L. Geinitzii*, Schimper.

*L. squamosus**, spec. nov., differs from *L. variabilis* in its larger size, and the much more lax and spreading nature of its bracts.

Lepidophloios acerosus, L. and H.; *Bothrodendron punctatum*, L. and H.; *B. minutifolium* (Boulay); *Sigillaria disciphora* (König.); *S. scutellata*, Brongn.; *S. Walchii*, Sauveur; *S. orbicularis*, Brongn.; *S. arzinensis*, Corda; *S. tessellata*, Brongn.; *S. camptotænia* (Wood).

Lycopod spores of forms called Triletes i., ii., vii., ix., xii., xiv., xxi., and Lagenicula ii.

Stigmaria ficoides (Sternb.) and var. *reticulata*, Göpp.; *S. stellata*, Göpp.; *Cordaites principalis* (Germar); *Artisia approximata*, Brongn.; *Cordaianthus pitcairniæ* (L. and H.); *Rhabdocarpus elongatus*, Kidston; *Cardiocarpus orbicularis*, Ett.; *Trigonocarpus Parkinsoni*, Brongn.; *Carpolithes bivalvis*, Göpp.; *Pinnularia capillacea*, L. and H.

424a. Kidston, R.—On *Lepidophloios* and the British species of the genus.

Trans. Roy. Soc. Edinburgh, vol. xxxvii. pp. 529–563, with two plates.

Owing to varying conditions of growth and preservation, specimens of this genus have been separated as *Lomatophloios* Corda, *Halonia*, L. and H., *Pachyphlæus*, Göppert, and *Cyclocladia*, Goldenberg (*non* L. and H.). The author gives a long review of the literature of the subject, from which it appears that the misunderstandings and differences have been almost innumerable, but the general result seems to be that the only ground of distinction of *Lomatophloios* rests on the position of the leaf-scar at the lower instead of the upper end of the leaf-cushions, and that "*Halonia*" is not a genus but only a condition taken by certain fruiting branches which belong, according to some, to various Lepidodendroid trees, but according to the author, to *Lepidophloios* alone; while *Ulodendron* is, in like manner, only a condition of the stems of several genera [*see* No. 422].

The author has examined a cast of the British Museum specimen, in which a halonial branch is supposed to be attached to a Lepidodendroid stem, and he finds that the latter has its leaf-cushions certainly with the long axis longitudinally placed like *Lepidodendron*, but as the leaf-scars are found *at the sides* of the cushions, they must have been swung round from their natural position, so that the stem is really a *Lepidophloios*. With regard to the direction of the leaf-cushions, specimens referred to *L. scoticus* have been compared, in which "the structure of the leaf-cushion and scar is identical in every respect," but in the small specimens the cushions are directed upwards, and in the larger downwards, the leaves themselves being always directed upwards. Nevertheless, "on no single specimen" has

the author "ever seen any transition from the upward to the downward directed leaf-cushion."

As to whether *Lepidophloios* is a condition of *Lepidodendron*, as supposed by Stur, the author cannot confirm that observer's statement that he has in the museum at Prague a stem with transverse leaf-cushions, showing a Lepidodendroid structure of leaf-scar, and cannot believe it. The specimens of *Lepidophloios* which he has examined have a distinct and much simpler structure, which he figures.

An amended full definition of the genus *Lepidophloios* is then given [here abbreviated]: Dichotomous, leaf-cushions upright or deflected, leaf cicatrix at or near the summit, transversely oval or rhomboidal, three punctiform cicatrules with the cicatrix, cones halonial when decorticated, but showing rosettes of deflected leaf-cushions on the cortex. Stem structure as in *Lepidodendron fuliginosum*, Williamson.

The British species are:—

*L. laricinus**, Sternberg.—Leaf-cushions directed downwards. Middle Coals, Yorkshire, Durham, and S. Wales.

*L. acerosus** (L. and H.).—Leaf-cushions directed downwards. Middle Coals, Lancashire, Shropshire, Yorkshire, South Wales; Lower Coals, Scotland, Durham, Lancashire, Yorkshire.

L. macrolepidotus, Goldenberg.—Possibly L. Carboniferous, Linlithgow.

*L. scoticus**, Kidston.—Leaf-cushions directed upwards in the young and downwards in the old branches. Small, rounded, and elongated. Calciferous Sandstone, Scotland.

425. Kidston, R.—On two of Lindley and Hutton's Type Specimens: I. *Rhacopteris dubia**, L. and H., sp.; II. *Sphenopteris polyphylla**, L. and H.

Proc. Roy. Phys. Soc. Edinburgh, vol. xi. pp. 238–241, pl. ix.

These types are still unique and are here refigured, and some remarks are made about the specimens.

426. Kidston, R.—On a New Species of *Bythotreptus* from the Lower Carboniferous of Lancashire.

Proc. Roy. Phys. Soc. Edinburgh, vol. xi. pp. 241, 242, pl. x.

The fossils are in soft grey shale; they are of brown colour, and composed of narrow, elongated, tubular cells. The species is called *Bythotreptus Worstonensis**, spec. nov. [fig. 28*c*]. From a basal stalk-like portion several branches are given off, which, by repeated dichotomy, form a frondose expansion; the apices are blunt and slightly swollen. From the shales below the Burdie-house Limestone, Worston Beck, near Clitheroe.

427. Kidston, R.—The Yorkshire Carboniferous Flora.

Trans. Yorkshire Nat. Union, part 18, pp. 65–127.

There are three reports here, viz. those for the years 1890, 1891, and 1892. In each is given a list of the Yorkshire Carboniferous Plants examined during the year to which the report relates, and at the end is a complete list of all recorded up to date. One of the names—*Sphenopteris spiniformis*, nom. nov.—is new, being assigned to the fossils figured by Sauveur (Véget. foss. de terr. Houill. de la Belgique, plate xx. figs. 1, 2) as *S. artemisiafolia*. The general list is as follows, † indicating species new to Britain, M. = Middle Coal-measures, L. = Lower Coal-measures, M. G. = Millstone Grit.

Calamitina varians, Sternb., M., L.
——— Göpperti (Ett.), M.
——— verticillata, L. and H., M.
——— approximata, Brongn., M.
——— undulata, Sternb., M.
Eucalamites ramosus (Art.), M., L.
——— cruciatus, Sternb., M.
Stylocalamites Suckovii (Brongn.), M., L.
——— cistii (Brongn.), M.
——— schatzlarensis, Stur, M.
Calamocladius equisetiformis (Sch.). M.
——— longifolius (Sternb.), M.
——— charæformis (Sternb.).
Calamostachys *cf.* longifolia, Weiss, M.
——— typica, Schimper, M.
Palæostachya pedunculata, Will., M.
——— gracillima, Weiss, M.
† ——— elongata (Presl), M.
Stachannularia northumbriana, Kidston, M.
Annularia microphylla, Sauv., M.
——— sphenophylloides (Zenker), M.
Equisetum Hemingwaysi, Kidston, M.
Sphenopteris obtusiloba, Brongn., M.
——— dilatata, L. and H., M.
——— trifoliolata, Brongn., M.
——— latifolia, Brongn., M.
——— acuta, Brongn., M.
——— spiniformis, Kidston, M.
† ——— Jacquoti (Zeiller), M.
——— Marrattii, Kidston, M.
——— rotundifolia, Andr., M.
——— cristata, Brongn., M.
——— Hoeninghausi, Brongn., M.
——— Laurenti, Andr., M.
——— Zobelii, Göpp., M.
——— Sternbergi (Ett.), M.
——— furcata, Brongn., M.
Eremopteris artemisiæfolia (Sternb.), M.

Renaultia Footneri (Marratt), M.
——— schatzlarensis (Stur), M.
Hymenotheca Dathei, Potonié, M.
Zeilleria delicatula (Sternb.), M.
Crossotheca schatzlarensis (Stur), M.
Oligocarpia Brongniarti (Stur), M.
Urnatopteris tenella (Brongn.), M.
Mariopteris muricata (Schl.), M., M. G.
Dactylotheca plumosa (Artis), M.
——— dentata (Brongn.), M.
Pecopteris Miltoni (Artis), M.
——— Volkmanni, Sauveur, M.
Alethopteris lonchitica (Schl.), M.
——— decurrens (Artis), M.
——— Davreuxi (Brongn.), M.
——— valida, Boulay, M.
Odontopteris brittanica, Gutbier, M.
Neuropteris heterophylla, Brongn., M.
——— Grangeri, Brongn., M.
——— tenuifolia (Schl.), M.
——— rarinervis, Bunbury, M.
——— gigantea, Sternb., M.
——— obliqua (Brongn.), M.
——— Scheuchzeri, Hoffm., M.
——— Osmundæ (Artis), M.
——— acuminata (Schl.), M.
Rhacophyllum crispum (Gutbier), M.
Megaphyton frondosum, Artis, M.
Lepidodendron ophiurus (Brongn.), M.
——— lycopodioides, Sternb., M.
——— obovatum, Sternb., M., L.
——— aculeatum, Sternb., M., L.
——— Haidingeri, Ett., M.
——— Wortheni, Lesqx., M.
Lepidophloios laricinus, Sternb., M.
——— acerosus (L. and H.), M., L.
Lepidostrobus variabilis (L. and H.), M., L.

Lepidostrobus lanceolatus (L. and H.), M.
——— ornatus, Brongn., M.
——— anthemis (König.), M.
——— Geinitzii, Schimper, L.
Bothrodendron punctatum, L. and H., M.
——— multifolium (Boulay) M.
Lepidophyllum majus, Brongn., M.
Sigillaria discophora (König.), L.
——— mammillaris, Brongn., M.
——— scutellata, Brongn., M.
——— ? Boblayi, Brongn., M.
† ——— polyploca, Boulay, M.
——— ovata, Sauveur, M.
——— principis, Weiss, M.
† ——— tenuis, Archepohl, M.
——— Saulii, Brongn., M.
——— reniformis, Brongn., M.
——— lævigata, Brongn., M.
——— deutschiana, Brongn., M.
——— elongata, Brongn., M.
——— rugosa, Brongn., M.
——— camptotænia (Wood), M.
——— tessellata, Brongn., M.
——— elegans, Brongn., M.
Stigmaria ficoides, Sternb., M., L.
——— reticulata, Göpp., M.
Sphenophyllum cuneifolium (Stern.), M.
——— majus, Bronn, M.
Sphenophyllum *cf.* oblongifolium, Germar, M.
——— myriophyllum, Crèpin, M.
——— trichomatosum, Stur, M.
Cordactes principalis (Germar), M.
——— borassifolius (Sternb.), M.
Dorycordaites palmæformis (Göpp.), M.
Artisia transversa (Artis), M., M. G.
Cordaianthus pitcairnia (L. and H.), M.
——— Volkmanni (Ett.), M.
Cardiocarpus Gutbieri (Geinitz), M.
——— marginatus, Artis, M.
——— Cordai (Geinitz), M.
——— subacutus (Grand'Eury), M.
——— fluitans, Dawson, M.
Trigonocarpus Parkinsoni, Brongn., M.
——— oblongus, L. and H., M.
——— Nægerathii (Sternb.), M.
——— ovalis, L. and H., M.
Rhabdocarpus sulcatus, Prestl., M.
——— elongatus, Kidston, M.
Carpolithes inflatus, Lesqx., M.
——— bivalvis, Göpp., M.
——— ovoideus, Göpp., M.
Pennularia prostrata (Artis), M.
Gnetopsis, sp., M.

This last includes the species recorded in No. **494**, 1890, with corrections.

***428. Hick, T.—The Fruit-Spike of *Calamites*: a chapter from the history of Fossil Botany.**

Natural Science, vol. ii. pp. 354–359.

The fossil spike now known as *Calamostachys Binneyana* was considered by Carruthers, Schimper, and Binney to be the first of a Calamite, on account of its possessing whorls of stalked sporangiopores with peltate heads, notwithstanding that the axis was described as having a bundle of scalariform tissue in its centre. Williamson, however, in his several contributions to the Phil. Trans., has again and again urged that this central vascular axis was inconsistent with Calamitean affinities, and has described also a specimen which showed macrospores and microspores as in some of the Lycopodiaciæ. Hence he has argued that the spike is more likely to be Lycopodiaceous, and to have strong affinities to *Asterophyllites*. The author now states that he has examined fresh material, an account of which will shortly be printed.

***429. Hick, T.**—*Calamostachys Binneyana* **(Schimper).**

Rep. Brit. Assoc. for 1892, p. 776.

This contains the same information and arguments as No. **428.**

431. Kidston, R. — On the occurrence of *Arthrostigma gracile*, Dawson, in the Lower Old Red Sandstone of Perthshire.

Proc. Roy. Phys. Soc. Edinburgh, vol. xii. pp. 102–111.

The author considers that *Arthrostigma* cannot be identified with *Psilophyton*, and that certain figured specimens from the Lower Old Red of Perthshire belong to the former genus, the only points open to discussion being the spiral or whorled arrangement of the leaves, their falcate or straight character, and the size of the stems. The leaves are spine-like, and leave circular scars like those on a *Stigmaria*.

***432. Seward, A. C.—Notes on Specimens of *Myeloxylon* (Brongn.) from the Millstone Grit and Coal-Measures.**

Rep. Brit. Assoc. for 1892, pp. 776, 777.

The account of this fossil is more fully given in No. **433.**

***433. Seward, A. C.—On the genus *Myeloxylon* (Brongn.).**

Annals of Botany, vol. vii. pp. 1–20, plates i., ii.

The particular specimen which forms the subject of this paper is from a magnesian limestone of Millstone Grit age near Lancaster. It consists of a portion of two stems lying against each other, and showing a rod-like appearance superficially. The rods are isolated bundles of tissue which have weathered out. The tissue is divided by dark lines, as seen in transverse section, into a number of polygonal compartments, but this is considered to be due to an accident of fossilization. Three real structures are shown, viz.: the vascular bundles, the parenchyma with scattered canals, and the hypodermal tissue. The vascular bundles show the xylem portions well preserved, but the phloem is always absent. The xylem, as actually seen, occupies various positions in the bundle; sometimes it is almost central, and at others it is attached to the parenchyma at one or two points only, in which case the tracheids next the vacant area are the smallest. These tracheids appear to be scalariform, reticulate, and spiral. The parenchyma consists of equal-sized cells, except round the bundles, where they are smaller; the canals are most numerous near the periphery, and they are bordered by some tangentially elongated cells. The hypodermal sclerenchymatous tissue alternately radially with parenchymata.

In the smaller specimen a bundle is found which is clearly of the collateral type, showing that the others not indicating this type have been displaced during fossilization. The smaller tracheids next the phloem part the author regards as protoxylem. The smaller parenchymatous cells surrounding the bundle are here thick-walled; also the canals are more numerous than in the larger specimen, and show dark contents.

These specimens are referred in a general way to *Myeloxylon radiata*, Renault, with two slides of which in the Binney collection they have been compared. In one of these the phloem is preserved, and is seen to be collateral with the xylem, and in another part the xylem is in the form of an oblong group of tracheids, and the phloem in two distinct groups on the same side of the xylem. In both thickened mechanical elements are noticed on the xylem side. The longitudinal section shows spiral tracheids, representing protoxylem on the phloem side of the xylem.

By a historical summary it is shown that *Myeloxylon* was generally referred to the Marrattiaceæ until Schenk suggested Cycadean affinities, and the belief in this affinity has since grown stronger. The contrary argument that it must be a fern, because *Alethopteris*-like leaves have been found attached to it, is answered boldly by the author in the question—"Why should not *Alethopteris* then be the leaf of a Cycad?" The branching of the stem is also not against this affinity, for *Bowenia*, a living Cycad, branches. Its vascular bundles are not concentric, as in *Angiopteris*, the type of tracheid is different, and the tangentially elongated cells surrounding the canals are peculiar to Cycads. The hypoderm is quite as Cycadean as Pteridian. Again, the protoxylem in ferns is not on the side of the xylem, next to the phloem, as in these specimens and in Cycads. The general arrangement of the bundles is fairly well matched amongst Cycads, as are many other structures, so that the author concludes, on the whole, that *Myeloxylon* "probably occupies a position between Cycads and Ferns, but nearer to the former than to the latter."

***434. Bower, J. O.—On the Structure of the Axis of *Lepidostrobus Brownii*, Schimper.**

Annals of Botany, vol. vii. pp. 329–354, plates xvi., xvii.

The author, after discussing the origin of lacunæ in the stems of certain fossil plants, such as *Stigmaria* and *Lepidendron*, gives the result of a re-examination of the sections of *Lepidostrobus Brownii* which are preserved in the British Natural History Museum.

In transverse sections there is seen a central axis, then a clear space, and then the outer cortex; and in the clear space

appear the cross sections of the leaf-trace bundles, which, in longitudinal sections are found to be connected with the surrounding tissue of filaments. Going into details, the author thinks that a layer of cells between the xylem and inner cortex represents an endodermis. If a true phloem were present with this layer, it can only have existed in comparatively small quantity. The features thus described are said to resemble those of the *Psilotaceæ*. The author can find no evidence in the leaf-trace bundles that they were diarch, still less that they were concentric. On the contrary, a figure is given showing a collateral type. As the bundle passes outwards it becomes surrounded by a lax, lacunar sheath, which ends by forming the trabeculæ which unite the bundle to the cortex. A similar trabecular tissue may have surrounded the central stile, but in the specimen there is a clear space only. Comparisons are then made with the cortical and other tissues of various species of *Lycopodium* and *Selaginella*.

435. Swanston, W. — The Silicified Wood of Lough Neagh.

The Irish Naturalist, vol. ii. pp. 62–66 and 102–106.

An account is given of the various notices of this wood, particularly of Dr. Barton's lecture on the subject in 1871, and of Dr. Scouler's description in 1837, both of whom stated that the masses of wood came from the lignite beds. In the memoirs of the Geological Survey, however, all the masses are considered to have been enclosed in the basalt. The author has now re-examined the spot described by Dr. Barton, and in a lignite pit there has found masses of wood in which the central portion is very stony. These lignites are associated with ironstone nodules containing plant-remains, which Mr. Starkie Gardner has shown to be of Eocene age.

***436. Reid, C.—On *Paradoxocarpus carinatus*, Nehring, an Extinct Fossil Plant from the Cromer Forest Bed.**

Trans. Norfolk and Norwich Nat. Soc., vol. v. pp. 382–386.

The fruit in question is a small bolster-shaped one, found in the peaty lacustrine deposits at Cromer and Lowestoft, which belong to the Forest Bed series: also at St. Cross in Suffolk, in a lacustrine deposit with Palæolithic implements. The fruit has been described by Nehring [No. **344**, **1892**], and is now refigured. The endocarp is 11 mm. long, cylindrical, with the proximal end sharply curved, keeled dorsally, and with external tubercles, indehiscent. Seed pendulous; testa with a caruncula. They have been referred by Potonié to *Folliculites*, Zenker, but

in that case the fruits from the Isle of Wight and Bovey Tracy, which have hitherto been referred to that genus, must be transferred elsewhere, as the genus is certainly different. It appears to be uncertain whether the plant belongs to the Anacardiaceæ or to the Naiadaceæ, but the author rather inclines to the latter view.

MINERALOGY.

THEORETICAL.

***437. Kelvin, Lord.—On the Elasticity of a Crystal according to Boscovich.**

Phil. Mag., vol. xxxvi. pp. 414–430.

In this paper the word "crystal" is only used to signify a homogeneous assemblage of equal and similar molecules. A crystal, according to Boscovich, is a homogeneous assemblance of equal and similar groups of mutually attracting or repelling points. The questions discussed are purely physical.

***438. Kelvin, Lord.—On the Theory of the Pyro-Electricity and Piezo-Electricity of Crystals.**

Phil. Mag., vol. xxxvi. pp. 453–459.

The author explains these properties by the assumption that the several molecules form electric couples, whose relations are altered by heat or pressure.

***439. Judd, J. W.—Additional Note on the Lamellar Structure of Quartz Crystals, and the Methods by which it is developed.**

Min. Mag., vol. x. pp. 123–135, plates iii., iv.

Brewster drew the following distinction between amethyst and quartz: that the former, whatever might be its colour,

showed, on fracture, a regular rippled surface like engine-turning, while quartz showed no such surface. Mr. T. H. Butler, however, has constructed a machine by which minerals and rocks may be broken in any desired direction, and it is found that a certain specimen of quartz from Brazil which shows no rippling on ordinary fracture, shows it very strongly when broken in this machine under great pressure, in an equatorial direction. The same is more strikingly the case with a quartz crystal from Madagascar. It is found that the ripples are parallel to the planes of R (100) and — R (T. 2·2), though they gradually twist and die out. The principal object, however, of this paper is the discussion of the optical properties of an "amethyst" believed to have belonged to Sir David Brewster. Of this a figure is given as seen in polarized light. From the centre three bands of a pale yellow tint radiate at angles of 120°. These, at various distances from the centre, expand into sectors of 60°, one of which is double, the one half being right-handed and the other left-handed, and they produce the phenomenon of Airy's spirals, where they overlap along the central line. The remainder of the crystal is purple, and shows lamellar structure. Each sector is in two parts, in either of which the lamellæ are parallel to the adjacent yellow band, but towards the circumference they become irregular, and are deflected through 30° when they reach the yellow sectors. These portions show no trace of circular polarization, but in the central parts give the interference figures of a uniaxial crystal, and in the circumferential parts those of a biaxial crystal. These lamellæ are comparable to the rippled fracture of "amethyst" quartz. The colour disappears on heating, but the structure does not, so the two are not related. It is thought that the lamellar portion was formed subsequently to the yellow portion; indeed, as the lamellæ appear in some parts to be related to the cracks, the structure was probably produced after the formation of the whole crystal. The author distinguishes the two portions as *stable* — the yellow, and *unstable*— the purple. In the latter alone were mechanical stresses able to set up a lamellar structure. It is the unstable variety of quartz in general that shows the lamellæ on etching, or the rippled surface under pressure. The stable variety is more often yellow and the unstable purple, but the two are seldom found together in the same crystal as here.

*440. Howard, F. T.—Stages in Crystallization.

Rep. and Trans. Cardiff Nat. Soc., vol. xxiv. part ii. pp. 23, 24.

Gives an account of Vogelsang's experiments on the formation of Cumulites, Crystallites, Microlites, etc.

441. McMahon, C. A.—Notes on the Microchemical Analysis of Rock-forming Minerals.

Min. Mag., vol. x. pp. 79–122, plates i., ii.

Part I.: Methods.—The author adopts the process of converting the bases to be examined into sulphates, by treating the mineral, when necessary, with hydrofluoric acid, by the aid of heat, adding sulphuric acid and evaporating to dryness. The sulphate thus obtained is dissolved, and allowed to evaporate slowly on a slide without heat.

Part II. is a table showing the properties of the resulting sulphates, by means of which the element predominant in the mineral may be discovered. In the following abstract the polarization tint is given by the order in Newton's scale, and by optical obliquity is meant the angle between the major axis of electricity and the direction of elongation: it is determined by a quartz wedge, whose edge is parallel to the major axis when it produces the maximum "thinning" (*cf.* Q.W. added=with edge of quartz wedge).

MICROCHEMICAL ANALYSES OF ROCK-FORMING MINERALS.

Salt.	Polarization Tint.	Optical Obliquity.	Form, etc.
$Al_2(SO_4)_3 + 18 H_2O$	1st order	45°	Six-sided tablets or radiating tufts; boundaries of platy crystals, marked by fine dark lines.
$BaSO_4$	1st order	0°	Modified rhombic or rectangular prisms or × shaped crystals, extinguishing at 45° from the arms of ×.
$BeSO_4 + 4 H_2O$ (*a*)	7th order	90°	Prisms with pyramidal ends (shew cross) are negative.
(*b*)	—	0°	Radiating.
$BeSO_4 + 7 H_2O$	3rd order	large	In prisms, sometimes twinned.
$BeSO_4 K_2SO_4 + 2 H_2O$	1st order	—	Globulites, axis in quadrants perpendicular to edge of quartz wedge.
$CaSO_4$	2nd to 4th	0°	Prism, pinacoid and base, boat-shaped; interference figure on macropinacoid base
$CaSO_4 + 2 H_2O$	1st order	38°	Acicular or swallow-tailed prisms or rhombic prisms.
$CaSO_4 K_2SO_4 + H_2O$	1st order	3° from 10°	Tabular, 6 or 8 sides.
$CaSO_4 Na_2SO_4$ (*a*)	2nd blue	large	Rhombic outline with rib.
(*b*)	low	various	Radiating fibres.
$Ce(SO_4)_2 + 7 H_2O$	—	—	Reniform mass.
$Ce_2(SO_4)_3$	—	—	Needle-shaped; straight extinction.
$Ce_2(SO_4)_3 + 8 H_2O$	7th order	great	Prisms with clinodomes, extinguish at 25° with vertical edge; absorption.

$Ce_2(SO_4)_3 + 9H_2O$ (*a*)	1st order	90°	Prisms and pyramids.
(*b*)	—	90°	Radiating fibres.
(*c*)	—	0°	Radiating tables.
$CoSO_4 + 4H_2O$	—	—	Peach-blossom coloured powder.
$CoSO_4 + 6H_2O$	—	—	Crystals.
$CoSO_4 + 7H_2O$	2nd order	30°	Crystalline crusts, occasionally tabular; dichroic.
$CoSO_4K_2SO_4 + 6H_2O$	high	nearly 90°	Tabular, six or eight faces, truncations; extinction near long axis, dichroic, zonal, often twinned, changes colour on heating.
$CoSO_4(NH_4)_2, SO_4 + 6H_2O$	3rd to 6th	8°	Large stumpy prisms; absorption, changes colour on heating.
$Cr_2(SO_4)_3$	—	—	Crystalline, red on heating, insoluble in alcohol.
$Cr_2(SO_4)_3 + 5H_2O$	—	—	Non-crystalline, green, soluble in alcohol.
$Cr_2(SO_4)_3 + 15H_2O$	—	—	Green in transmitted light; violet, insoluble in alcohol.
Cs_2SO_4	2nd order	90°	Prisms with many faces.
$FeSO_4 + 7H_2O$	7th order	—	Rhombs or tabular prisms.
$Fe_2(SO_4)_3$	1st order	0°	Oval or rounded discs with radiating fibres; extinction with long axis; absorption.
$Fe_2(SO_4)_3$	2nd blue	0°	Radiating needles.
$Fe_2(SO_4)_3 + 9H_2O$	—	—	Prisms with terminal edges replaced.
$Fe_3(SO_4)_4 + 12H_2O$	—	—	Yellow crystals.
FeS_2O_7	—	—	Green microscopic grains—by adding much H_2SO_4.
$FeSO_4(OH)_4 + Fe(OH)_6 + H_2O$	—	—	Massive, earthy, stalactitic.
$Fe_2(SO_4)_3 + Fe_2(SO_4)_2(OH)_2 + 10H_2O$	2nd red	0°	Six-sided, crystalline scales; basal section gives cross on blue ground.
$2Fe_2(SO_4)_2(OH)_2 + Fe_2SO_4(OH)_4 + 24H_2O$	—	—	Delicate fibres, pale yellow to white, pearly or silky.
$FeSO_4Na_2SO_4 + 6H_2O$	2nd order	15°	Globulites and spherulites.
$FeSO_4K_2SO_4 + 6H_2O$	7th order	variable	Large tabular crystals; absorption.
$FeSO_4(NH_4)_2SO_4 + 6H_2O$	5th order	small	Large stout prisms and skeletons; absorption, zonal, emergence of optic axis or bissectrix.
K_2SO_4	2nd order	0° or 90°	Flat, elongated prisms.
$KHSO_4$	6th order	small	Six-sided or irregular tabular prisms or needle-shaped; absorption, irregularly shagreened; penetration twins.

Salt.	Polarization Tint.	Optical Obliquity	Form, etc.
$K_2 S_2 O_7$	—	—	Long, slender needles.
$Li_2 SO_4 + 3 H_2O$	7th white	90°	Six-sided, elongated prisms, tabular or radiated; negative bissectrix shown.
$Li\ K\ SO_4$	to 2nd pink	0°	Prisms with pyramids; absorption.
$Li\ Na\ SO_4$	3rd order	various	Spherulitic: traces of lemniscates.
$Li\ NH_4\ SO_4$	to 2nd blue	90°	Large six-sided micaceous-looking prisms.
$Li\ Rb\ SO_4$	nearly none	90°	Hexagonal, tabular rectangular plates or fibrous.
$Mg\ SO_4 + H_2O$	—	—	Prisms or granular masses.
$Mg\ SO_4 + 7 H_2O$ (*a*)	2nd order	90°	Needle-shaped, radiating prisms; absorption.
(*b*)	less than 7th	0° or 90°	Stout prisms.
$Mg\ SO_4\ Na_2\ SO_4 + 6 H_2O$ (*a*)	1st order	45° Q. W.	Crystals like radiating primrose leaves; absorption.
(*b*)	7th order	large	Elongated, radiating prisms.
(*c*)	2nd blue	90° Q. W.	Spherulitic.
$Mg\ SO_4\ K_2\ SO_4 + 6 H_2O$	over 7th	—	Large irregular crystals; absorption partial, dusty appearance.
$Mg\ SO_4\ (NH_4)_2\ SO_4 + 6 H_2O$ (*a*)	3rd order	8°-9°	Elongated prisms with complex ends; absorption, zonal, extinction 5°-8° with long axis, optic axis emerges, cavities with bubbles.
(*b*)	7th order	—	Stumpy prisms.
$Mg\ SO_4\ Cs_2\ SO_4 + 6 H_2O$	6th order	—	Large tabular, irregular prisms; absorption, cavities with bubbles.
$Mg\ SO_4\ Rb_2\ SO_4 + 6 H_2O$	5th order	large	Rhombs; absorption.
$Mn\ SO_4 + 5 H_2O$	7th order	large	Platy mass of felted, blade-like crystals; absorption, negative bissectrix shown.
$Mn\ SO_4\ Na_2\ SO_4 + 2 H_2O$ (*a*)	2nd pink	90°	Almond-shaped granules.
(*b*)	2nd pink	90° Q. W.	Spherulitic.
(*c*)	—	—	Short cube-like prisms.
$Mn\ SO_4\ K_2\ SO_4 + 2 H_2O$	2nd blue	0° Q. W.	Spherulitic or confused.

$MnSO_4 (NH_4)_2 SO_4 + 6 H_2O$	3rd order	—	Large stumpy, complex prisms; absorption, some zonal, others with bubbles, many show optic axis.
$Na_2 SO_4 + 10 H_2O$	1st grey to 2nd blue	small	Short stumpy prisms with many faces; crystals with broad border.
$NaHSO_4$	6th or 7th	various	Long blade-like prisms or granules; penetration twins.
$(NH_4)_2, SO_4$	less than 6th	90°	Long flat prisms; long cavities with bubbles.
$(NH_4) H SO_4$	very high	90°	Stumpy, complex prisms, often six-sided; twins.
$Rb_2 SO_4 (a)$	4th order	—	Six-sided plates.
(b)	—	90°	Lath-shaped, with ragged ends.
(c)	—	various	Regular crystals; absorption, multiple twinning.
$Sr SO_4$	1st white	0°	Globulites, round discs, and prisms.
$(Ti O) SO_4$	—	—	White-hard mass.
$Ti_2 (SO_4)_3 + 3 H_2O$	—	—	Yellowish, diliquescent.
$Ti_2 (SO_4)_3 + 8 H_2O$	—	—	Crystals in tufts.
$Zr (SO_4)_2 + 4 H_2O$	3rd order	0°	Spherulites, elongated lozenges, and six-sided plates; absorption, lozenges scored by dark lines, swells on heating with alum.

Part III. consists of various notes on the detection of the various elements, both microscopically and chemically [impossible to abstract].

442. McMahon, C. A.—Microchemical Analysis of Rock-forming Minerals.

Western Micr. Club Abs. Proc., 10th session, pp. 9–11.

A short account of the author's researches, as in No. **441**.

443. McMahon, C. A.—Notes on the Optical Characters of the Globules and Spherulites of Lithium Phosphate and some other salts.

Min. Mag., vol. x. pp. 229–232, plate v.

Lithium phosphate being an artificially produced substance, this paper has but a remote bearing on geology.

***444. Sollas, W. J.—On the Law of Gladstone and Dale as an Optical Probe.**

Sci. Proc. Roy. Dublin Soc., vol. viii. pp. 157–166.

The full memoir is to be published in the Transactions.

The recognized facts on which the argument of this paper is founded are as follows: If n be the refractive index of any substance and d its density, then $\frac{n-1}{d}=k$ its refractive energy, and this quantity multiplied by m the molecular weight is its refractive equivalent. The law may then be stated that "the elements retain their refractive equivalents unchanged in the state of chemical combination," so that "the refractive equivalent of any compound is the sum of the refractive equivalents of its elements or minor groups." In the case of a doubly refracting crystal, the refractive index is taken to be the mean of the three indices, no special ray being particularized. The object of the present paper is to find a meaning for the above law in the case of the separate indices. For this purpose the author gives to the word density an optical meaning, so that he can write "the density of the crystal may be different in different directions," and he suggests that by knowing the refractive indices in the several directions in a crystal we may determine the arrangement in those directions of the elements of the molecules. Several salts are taken for examples, and the process followed is this: From considerations of symmetry or otherwise some constitution is suggested, *e.g.* that some of the elements are linked vertically and the rest horizontally. The refractive energy of the vertical group is then obtained by dividing the sum of the known values of the refractive equivalents of the elements involved by the sum of their

molecular weights. The number thus obtained is then used in the formula above given to determine the optical density in that direction, and the same is done for the horizontal group of elements. A test is then applied to see if the grouping thus suggested is correct. This test is derived from the following statement: "The study of atomic volumes has rendered it highly probable that the sum of the atomic volumes of the constituents of a compound is equal to the total volume of the compound, and if this be so, then the sum of the partial volumes should be equal to the volume of the whole salt." To apply this test the molecular weight of the vertically linked groups is divided by the density obtained for that group, which gives its volume, and the same is done for the horizontal group. These two volumes are then added, and the result is found in all the cases dealt with to correspond closely with the atomic volume of the whole, obtained independently by dividing the total atomic weight by the known density of the substance. This correspondence is considered to render probable the constitution originally suggested.

From this arises a theory of pleochroism, *e.g.* in a compound of copper. The vertical grouping may require the metal in that group to be cupric, and hence to give blue tints; while in the horizontal grouping the metal may be cuprous, and so give green tints.

*445. Harker, A. — Extinction Angles in Cleavage Flakes.

Min. Mag., vol. x. pp. 239, 240.

The extinction angle measured in a plane oblique to the opticaxial plane will be less than the maximum. It is here shown that if a is the maximum extinction angle, 2ν the angle between the optic axis, and ϕ half the cleavage angle, *i.e.* the angle between two principal cleavages, then the extinction angle in a cleavage flake is—

$$\tfrac{1}{2}\left\{\tan^{-1}\left[\sin\phi,\ \tan\overline{a+\nu}\right]+\tan^{-1}\left[\sin\phi,\ \tan\overline{a-\nu}\right]\right\}$$

Taking the cleavage angles of hornblende and augite, the author works out tables showing the value of this for various values of a and ν.

MINERALS.

*446. Kelvin, Lord.—On the Piezo-Electric Property of Quartz.

Phil. Mag., vol. xxxvi. pp. 331–342.

An attempt to explain on physical principles the curious discovery of Messrs. Curie that if a plate of quartz be cut

parallel to any one of the normal planes of symmetry, and this be hung vertically with a weight attached to it, one side will become positively, and the other negatively, electrified. It is necessary for the explanation proposed that quartz should be considered to consist of groups of three SiO_2 molecules clustered together, an arrangement diagrammatically illustrated by a six-linked ray of O_2 and Si alternately.

447. Heddle, M. F., and Thompson, J. S.—On the "Skin" of Agates.

Min. Mag., vol. x. pp. 248–250.

Certain agates found at the "Blue Hole," near Usan, Forfarshire, are coated with a green skin of spec. grav. 2·605. This yields on analysis:—

Silica	51·742
Alumina	4·443
Ferric oxide	11·911
Ferrous oxide	4·195
Lime	0·535
Magnesia	8·288
Potash	7·399
Soda	0·552
Water	11·491
	100·556

This composition accords fairly well with that of Celadonite, with possibly a little admixture of Saponite and Delessite. The ingredients of this coating cannot all come from the disintegration of a single rock-forming mineral, but must be derived from several.

448. Louis, H.—On the Mode of Occurrence of Gold.

Min. Mag., vol. x. pp. 241–247.

A list is given of 77 species of mineral which are known to occur in auriferous lodes, of which, however, only 12 are plentiful; and the author suggests that gold and quartz have been brought together into the reefs by an alkaline solution, but offers no explanation of their deposition, nor of the association of silver with gold.

449. Lobley, J. L.—The Genesis of Gold.

Journ. City of London Coll. Sci. Soc., Oct. 1893.

The author argues against the igneous origin of gold, that it is not found in volcanic regions, which he proves by citing various cases, particularly that of Vesuvius, where it is unknown, even amongst the 112 mineral products of that mountain. He thinks that under due conditions of heat, silica may combine with gold, and then their "separation would be brought about

by the segregation of the silica of the silicate of gold." He further thinks that gold may be precipitated from its solution in the water by the action of organic matter, and thus form part of ordinary sedimentary deposits.

450. Liversidge, A.—Magnetite in Minerals and Rocks.

Iron, vol. xli. p. 292.

From the Trans. Australian Assoc. The magnetic particles in a number of minerals were separated by an electro-magnet, of 18 oz. lifting power, with the following results:—

Two hæmatites, micaceous hæmatite (1), brown hæmatite, gothite, siderite, dufrenite, spinel (2), garnet, chrome iron ore (1), auriferous hæmatite, bornite, iron pyrites, tinstone, and Scotch serpentine (1), yielded none; but hæmatite from Elba 15 per cent., micaceous hæmatite (1) trace, spinel small quantity, franklinite 32·23, chrome iron ore 0·69 and trace, pyrrhotine all, serpentine 3·589, 7·99, 2·79, 5·10, trace, 3·19, 14·28, trace, 22·99.

***451. Miers, H. A.—Spangolite, a remarkable Cornish mineral.**

Nature, vol. xlviii. pp. 426, 427.

On some copper ores from St. Day's Mines are found some bright green crystals, of the rhomboidal system, with pyramidal angle 53°7, with perfect basal cleavage, uniaxial, negative, of spec. grav. 3·07, soluble in acid. In composition it is a hydrated sulphate and chloride of copper and aluminium. These characters show it to be a second example of the mineral spangolite of which the first was described by S. L. Penfield, in 1890, from America.

452. Heddle, F. M.—On Pectolite and Okenite from new localities; the former with new appearances.

Trans. Geol. Soc. Glasgow, vol. ix. pp. 241–255.

Pectolite has been discovered in large masses on the shore of Torosay, in Mull. It is in the form of round balls of the size of a man's head, which have come out of amygdaloid cavities. They are so tough that the larger ones can scarcely be broken by a 12 lb. hammer, and the surface of fracture shows interfering groups of crystals. These characters so closely resemble those of pectolite, that an analysis would have been considered unnecessary but that the crystals, instead of being flat and scaly, form divergent, acicular, or rosette-like groups. One of the balls looked on fracture so much like gyrolite, that the author attempted to make a thin section of it, but this was found

impossible, as is the case with pectolite. The specimens, however, yield on analysis the following limits:—

Silica	52·95	53·74
Alumina	·82	1·76
Lime	31·19	33·41
Soda	8·04	9·94
Potash	0	2·42
Water	3·38	4·46

Both are therefore pectolite, and it thus is shown that a mineral of one composition may have much the appearance of another. At the locality mentioned these balls sometimes pass without change from one column of basalt to another across the joint, which shows that the columnar structure was set up after the filling of the cavity, and not therefore on cooling. The author has seen the same phenomenon in the case of an agate in the most southerly of the islets of the Inner Hyskier. In confirmation of the above conclusion several examples are cited, *e.g.* in Faroe, where the columns are not perpendicular to the walls of the dyke, and where indeed they impinge on each other. When such columns are quarried the cracks die out in depth, and the surface of the balls into which some of them divide show no difference of structure towards the outside.

Okenite is specially characteristic of Greenland, Iceland, and Faroe, but the south-west shore of Skye is a splendid locality for zeolites, if one can only manage to land, and from thence to between Lochs Einort and Brittle a specimen was brought which yields analysis A and from Dunan Sarr and Squirr with analysis B:—

	A	B
Silica	48·28	54·22
Alumina	4·14	·68
Lime	30·63	27·22
Soda	1·68	1·02
Water	15·69	16·64
Spec. grav.	2·198	2·246

These analyses, though not exactly those of okenite, are nearer to it than to any other mineral.

Some general notes on the optical properties of these two minerals are then given. In *Pectolite*, *e.g.* from Ratho, however thin the section everything appears in a haze; the structure is tesselated, lanceolate, or engine-turned; colours with nicols at 45° yellow, purple, and orange, or dark blue. *Wollastonite* shows lozenge-like structure. *Xonaltite* dark and pale blue under all treatment, structurally minutely specular. *Okenite* structure minute, blue or colourless; yellow with parallel nicols.

***453. Goodchild, J. G.—Note on the Minerals observed in the Railway Cutting at Barnton, near Edinburgh.**

Trans. Edinburgh Geol. Soc., vol. vi. pp. 301, 302.

The igneous rock of Corstorphine Hill is cut through at the north end by this railway, and in the outer part exhibits an ophitic diabase, mostly composed of plagioclase and pyroxene, and in the centre part a picrite, felspar being practically absent; and olivine, pyroxene, brown mica, and iron ore building up the holocrystalline rock, which weathers very rapidly [*cf.* No. **300**]. The shales in contact with this mass are much altered, and some bands have become aggregated into small spheroids; and along the divisional planes of the igneous rocks are various minerals, as pilolite, saponite, calcite, arragonite, opal, prehnite, analcime, pectolite, natrolite, and datolite.

454. Neilson, J.—A visit to the Island of Little Cumbrae, with some notes on its Minerals.

Trans. Geol. Soc. Glasgow, vol. ix. pp. 373–375.

The minerals found here are heulandite and cluthalite, a flesh-red variety of analcime. The best locality is Gull Point.

455. Thompson, J. S.—Note on a peculiar occurrence of Galena.

Min. Mag., vol. x. pp. 143, 144.

The galena in question occurs as isolated loose crystals in cavities in an otherwise solid sandstone belonging to the Old Red Sandstone at Aimville, near Kirknewton. Only one crystal occurs in any cavity, and many cavities have none. They are simple cubes. The overlying strata have been somewhat vitrified by a neighbouring whinstone.

PETROLOGY.

GENERALITIES.

***456. Sollas, W. J.—On a Method of Separating the Mineral Components of a Rock.**

Nature, vol. xlix. pp. 211, 212.

Fill a test tube with solutions of spec. grav. 3·3 to 2·5, so as to form a diffusion column as described in No. **437**, 1891; then put in the pounded rock substance, and it will distribute itself at various depths. To get any particular portion out, use for a pipette a tube fitted with a piston made by winding a little cotton thread round a stem of hard grass, and push this down to the end of the tube. When thus fitted put the end of the tube at the required spot and gently pull up the piston so as to suck

up what is wanted; then plug the end by another thin grass rod outside, bent round into a hook.

457. Barns, C.—The Fusion Constants of Igneous Rocks. Part II.: The Contraction of Molten Igneous Rocks in passing from Liquid to Solid.

Phil. Mag., vol. xxxv. pp. 173–190, plate v. [Part I. No. 359, 1892.]

The author has examined with great care the change of volume of diabase in passing from a liquid to a solid state. As a preliminary, he has also compared the density of the rock before and after fusion. As a mean of three experiments, he finds that the density of the original crystalline rock being 3·0178, the density of the obsidian-like product of fusion is 2·717, indicating a volume increment of 10 per cent. as the effect of fusion. Remarkable though this result is, the increase is not so great as those recorded in Zirkel's Lehrbuch for various minerals.

The method employed for observing the contraction on cooling and solidification was to place the molten mass in a vertical platinum tube, and to measure the depth of the meniscus at various temperatures above, below, and at the solidifying point. This gives the apparent contraction, and the corresponding contraction of the platinum being independently measured, the actual contraction is obtained. In two sets of experiments with numerous samples the following results were obtained:—

I. Mean actual contraction, solid $0^\circ - 1000^\circ = \cdot 0000250$ per $^\circ$
„ „ „ liquid $1100^\circ - 1500^\circ = \cdot 0000470$ „
Contraction on solidification at $1094^\circ = \cdot 0390$

II. Mean actual contraction, solid $0^\circ - 1000^\circ = \cdot 0000250$ „
„ „ „ liquid $1100^\circ - 1500^\circ = \cdot 0000468$ „
Contraction on solidification at $1092^\circ = \cdot 0340$

This shows that the original cold rock may be 8 to 10 per cent. more dense than the molten magma. Notwithstanding this fragments of the cold rock will float on the molten magma, which is easily accounted for by the fragment hollowing out and cooling a little boat-like surface on which it floats on the very viscous liquid below. It was not possible to make the test of submerging the rock fragment.

Since the fusion of diabase is thus perfectly normal, it follows that the melting point must increase with pressure, and by comparison of the present results with some previously obtained in the case of thymol, it is concluded that the critical pressure must be considerably above 10,000 atmospheres.

458. Barns, C. — The Fusion Constants of Igneous Rocks. Part III.: The Thermal Capacity of Igneous Rocks considered in its bearing on the relation of Melting Point and Pressure.

Phil. Mag., vol. xxxv. pp. 296–307, plate vi.

The method here adopted is to melt about 30 grammes of the same diabase as was employed in previous experiments in a platinum crucible, whose thermal capacity is known, supported in a vertically divided furnace by means of two crutch-shaped radial arms, which can be suddenly pulled asunder, so as to drop the crucible into a calorimeter underneath it. The temperature at various parts of the crucible is taken by a thermometer passing through the top of the furnace into a platinum tube in the middle of the crucible. Two series of results are given, the second being considered the more reliable, as the temperature of the crucible was more constant.

SERIES I.

Temperatures Cent.	829	880	1001	1025	1078	1166[1]	Solid.
Thermal capacities	·191	·204	·242	·253	·263	·311	
Temperatures	1274	1306	1337	1367	1378		Liquid.
Thermal capacities	·358	·364	·373	·370	·385		

Mean specific heat, solid 800°–1100° = ·304
" " " liquid 1200°–1400° = ·350

SERIES II.

Temperature	781	873	948	993	1096	1171[1]	Solid.
Thermal capacity	·180	·202	·227	·238	·268	·302	
Temperature	1166	1194	1197	1215	1218	1248	
Thermal capacity	·310	·318	·319	·327	·330	·339	
			1251	1251	1334	1352	Liquid.
			·340	·342	·377	·367	

Mean specific heat, solid 800° — 1100° = ·290
" " " liquid 1100° — 1400° = ·360

In both cases the latent heat of fusion reckoned at 1200° is 24 gramme-calories and at 1100° is 16 gramme-calories, the actual melting point not being observable.

Combining these results with those of No. **457** and applying the laws of thermodynamics, if τ be the *absolute* melting-point temperature and p the pressure, we find that $\frac{d\tau}{dp}$ has values variously calculated at ·019, ·029, ·019, and ·026. Hence, if θ_m

[1] Incipient fusion.

be the temperature of the melting point, the mean formula adopted is $\theta_m = a + \cdot 025\, p$. The value $\frac{d\tau}{dp}$ being within the limits which have been elsewhere calculated for wax, spermaceti, etc., it is inferred that, in all cases of the normal type of fusion, the relation of temperature to pressure is nearly constant, and *à fortiori* it is so for the same substance under different conditions of temperature and pressure.

459. Lea, M. C. — On Endothermic Reactions effected by Mechanical Force.

Chemical News, vol. lxviii. pp. 297, 298, and 308-310.

The geological interest in this paper consists in the light it throws on the possibility of rock changes being brought about directly by pressure, although the substances actually dealt with by the author are easily reducible metallic salts.

By bringing enormous pressures to bear, *i.e.* a million pounds to the square inch, directly on such substances it is shown in Part I. that "mechanical force can bring about reactions which require expenditure of energy, which energy is supplied by the mechanical force precisely in the same way that light, heat, and electricity supply energy in the endothermic changes which they bring about." In Part II. it is shown that shearing stress is enormously more powerful than direct pressure, so that friction in a mortar or rubbing prepared paper with a glass rod suffices to produce results. That these results are due to the direct action of the mechanical force, without the intermediate production of heat, is shown by the fact that some of the reactions are such as cannot be produced by heat.

460. Gooch, A. E.—On the Rise of Temperature due to the Action of Water upon various Rocks.

Collected Tracts, Kenny, printer, Ent. at Stat. Hall, pp. 27–32.

The author has conducted a number of experiments by crushing various rocks to a very fine powder, leaving them to resume the ordinary temperature, drying them without heat, adding distilled, or carbonated, or 8°/₀ acidulated water, and noting the rise of temperature. The following are his results: 1, rise of temperature in degrees Fahrenheit with distilled water; 2, with water charged with CO_2; 3, with 8°/₀ citric acid; and 4, with 8°/₀ H Cl.

Rock.	1.	2.	3.	4.
Sandstone	·45	·55	·6	·7
Limestone	·6	1·15	1·3	1·7
Clay Slate	·65	·65	·65	·65
Oxford Clay	·9	1·05	1·1	1·25
Gault	·9	1·15	1·25	1·45
Cave Earth	·7	1·2	1·25	1·3
Coal	·9	·9	·9	·9

***461. Harker, A.—Berthelot's Principle applied to Magmatic Concentration.**

Geol. Mag., Dec. 3, vol. x. pp. 546, 547. (Read at Brit. Assoc.)

According to Van t'Hoff, the concentration brought about by the action of Soret's principle will be inversely proportional to the absolute temperature. Seeing, however, that in some cases there is twenty-five times as much iron oxide at the side of a dyke as there is in the centre, this principle is quite inadequate to account for it. According to Berthelot's principle, every chemical change will be such as will evolve most heat, and in a magma near the point of saturation, whatever promotes crystallization will promote the most rapid evolution of heat. In an unequally heated magma, therefore, the best soluble ingredients must be accumulated in the part most easily saturated, *i.e.* the iron oxides will accumulate in the coolest portion, and this will go on till the magma is too viscid for any transference to take place.

IGNEOUS ROCKS.

***462. Hobson, B.—Granite.**

Geol. Mag., Dec. 3, vol. x. p. 91.

A protest against No. **365**, 1892.

***463. Harker, A.—On Porphyritic Quartz in Basic Igneous Rocks.**

Rep. Brit. Assoc. for 1892, p. 726.

Published in 1892 in the Geol. Mag. [*see* No. **372**, 1892].

464. Raisin, Catherine A.—Variolite of the Lleyn, and associated Volcanic Rocks.

Quart. Journ. Geol. Soc., vol. xlix. pp. 145–165, plate i.

Two types of igneous rock are described: one is a greenish compact rock, the other is reddish, and both show spherulitic growth. These two cannot always be separated, and may form parts of a single magma; the junction of the two sometimes taking place in the middle of a spheroid. Analyses of these two types are given.

These rocks weather into large spheroids, sometimes 6 ft. long, which have an outer coat of a different colour, on which variolitic structure is found. This coat is cracked in radial directions, while the interior is traversed by rhomboidal joints. "The outer layers are generally schistose and shining, consisting of palagonite, or of a chlorite or serpentinous aggregation which doubtless represents an originally glassy exterior." In some cases fluidal structures and flow brecciation can be

observed, and in one instance, at Perth Oer, a second movement of lava is thought to have thrust the magma between the spheroids. The spherulitic structure shows four modes of formation: 1, without radial structure; 2, the felspathic type; 3, the ferruginous type; and 4, with a grouped arrangement of distinct crystals. The variolite occurs in small bosses at Aberdaron and at places along the coast, at north of the beach of Porth Oer, near the small isthmus of Dina's-fach, and in the cliff south of Porth Union; details of which are given.

As to the origin of the variolites, it is suggested that the exterior of a spheroid might have a thin film formed on it, which will check the rate of cooling of the interior, so that crystallites begin to develop, the centres of growth being the spots where iron oxide segregates and concentric cracking takes place; the inner part cools more slowly, so that a confused intercrystallization takes place.

"Pseudo-crystallites" are noted in some examples, and certain secondary minerals are recorded.

In one of the indurated argillites at Pared-Uech-y-Menyn, on the south coast, which may, however, be an infolding of new rock, a new *Cypridina* was found, described in No. **404**.

***465. Cole, G. A. J.—The Rocks of the Volcano of Rhobell Fawr.**

Geol. Mag., Dec. 3, vol. x. pp. 337–345.

The holocrystalline rocks are limited to certain patches. One is an augite aphanite, with ophitic structure and free from olivine. Another is a similar rock intersected by abundant veins of compacter material. Others are similar, most contain pyrites, and some are coloured yellowish green by epidote. The andesites are partly augitic and partly more felspathic, the former being classed as basaltic and the latter as trachytic. In some the augite is porphyritic. One scoriaceous lava has its cavities full of chlorite, zeolites, etc.; another, east of Ty Canal, is hornblendic. The trachytic andesites form an important feature; they resemble phonolites and nephrites in various stages of decay, the felspars being largely converted into microcrystalline dusty areas, and the porphyritic pyroxenes into mere patches of calcite. These light-coloured rocks are intrusive, though some are scoriaceous. On Moel-y-Llan the rock is pyritous. In the boss west of Bwlch Goriwand, the pseudomorphs are after hornblende.

The greater mass of the volcano consists of tuffs and ashes, including large blocks, but on the whole of a fine-grained character. Some contain scoriæ, which weather away more easily than the purple matrix. The highest rock on Moel-Cors-y-Garnedd is a grey, highly felspathic ash; on the north and south are magnificent developments of hornblendic tuff,

looking like porphyritic lavas, forming the base of the volcano. In these tuffs the hornblende lies in the ground-mass between the fragments which resemble pieces of the lavas of Rhobell Fawr. A section of the ash from Rhobell-y-big is figured, showing both augite and hornblende, and some of the patches may possibly represent altered olivine. The associated grits do not appear to have been derived from the lava, but more probably from the older Harlech grits. The ovoid black and grey bodies, mentioned in a former paper, are now found to be isolated concrétions belonging to the pisolitic iron ores.

466. Waller, T. H.—Notes on some Welsh Lavas.

Proc. Birmingham Phil. Soc., vol. viii. (pt. i.) pp. 169–178.

The author mentions some felspar crystals which have been cracked and mended with new felspar, and thinks that the supposed quartz which is said by Miss C. Raisin to fill such a crack (Q. J. G. S., vol. xlv. p. 253) is probably also felspar. In a great block at Cwm Idwal may be seen an illustration of "thin tongues of lava poured out over the still soft mud of the Silurian sea." He then discusses the nodules of the felsites, and does not consider that they originally had a central cavity, or were spherulitic. He finds that they differ in character from the matrix, and have a banded structure whose bands cross the nodule; hence he concludes that they are pebbles of an older caught up in a newer lava-flow. Finally the riebeckite of Mynydd Mawr is noted.

467. Waller, T. H.—Notes on a Rock from Glyn Ceiriog.

The Midland Naturalist, vol. xvi. pp. 201–204.

The rock is a nodular one, which has been subjected to pressure, and the nodules are considered to be little pebbles of the same finer ash as the matrix in which they lie, which have been flattened and squeezed at the edges by the general regional pressure of the district.

***468. Woods, H.—The Igneous Rocks of the Neighbourhood of Builth.**

Rep. Brit. Assoc. for 1892, p. 710.

This abstract only states that the author dealt with certain rocks. (The full paper has been published in 1894.)

***469. Postlethwaite, J.—Notes on an Intrusive Sheet of Diabase and Associated Rocks at Robin Hood, near Bassenthwaite.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 531–535.

The exposures of the diabase, which was mapped by J. C. Ward, are traced in detail. About 300 ft. to the north of the intrusive sheet of diabase is a parallel bed of grit, and both have been searched for antimony. Analyses by **R. Hellon** and **J. E. Brockbank** are given of the diabase and of the grit.

Notes on the microscopic appearance of the diabase and of the associated Skiddaw Slates are also given.

***470. Tate, T.—Lake Country Rocks: Microscopically described.**

The Naturalist for 1893, pp. 247–251.

The following rocks are described as seen in their sections:—

Biotite granite, Shap; white porphyritic granite, Skiddaw; biotite granite, Eskdale; aplite, Waberthwaite; grey quartz-felsite, Threlkeld Quarry; red quartz-felsite, Low Rigg, St. John's Vale; augite granophyre, Carrock Fell; quartz-felsite, Armboth-dyke; quartz-felsite, Helvellyn-dyke; Buttermere syenite, Scale Force; granophyre, Ennerdale; gabbro, Carrock Fell; diabase, Castle Head, Keswick; chiastolite slate, Senen Gill, Skiddaw.

***471. Bulman, G. W.—The Great Whin Sill.**

The Field Club, vol. iv. pp. 113–117.

A popular article on its distribution and appearance in the field.

***472. Arnold-Bemrose, H. H. — On the Derbyshire Toadstone.**

Geol. Mag., Dec. 3, vol. x. p. 559. (Read at Brit. Assoc.)

There are at least two, and there may be three or four "beds" of this. It contains lead ore at Wakebridge Mine, where it is an olivine dolerite. This ore is as good in the Toadstone as it is in the Limestone, with which the former is contemporaneous. The overlying beds are not altered, and there are associated tuffs in various parts of the district.

473. Platt, S. S.—Notes on Rowley Rag Stone.

Proc. Assoc. Municipal and County Engineers, vol. xix. pp. 2.

Calls attention to the similarity of this rock to that of Clee Hill, quoting analyses of each side by side. The Clee Hill rock was described microscopically in vol. xvii. p. 265. A list of twelve papers on the Rowley Rag is given.

***474. Fox, Howard, and Teall, J. J. H. — Notes on some Coast Sections at the Lizard.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 199–210.

At Potstone Point the serpentine and hornblende schist are so interbanded that a microscopic section may be prepared to illustrate it. Bands of hornblende schist, in which the hornblende is brown and accompanied by malacolite and altered felspar. alternate with bands of olivine, hornblende, and serpentine in a network of magnetite. There are also lenticles of serpentine in the schist with the foliation planes winding around them. In the slopes of the cliff above the point, the hornblende schist and serpentine are seen in an S-like fold. On the level ground at the top of the cliff there is an isolated mass of hornblende schist, surrounded by serpentine, which is seen to overlap it all round with a wavy junction. This mass is the summit of a gentle dome, exposed by the removal of the overlying serpentine.

Numerous basic dykes are here to be seen, which are porphyritic in the centre, but become foliated on the sides. Here the felspars of the ground-mass are broken and displaced, and there are cases of altered augite penetrated by bath-shaped felspars, and the interstitial matter has consolidated as fibrous hornblende. Thus the foliation has been produced after the consolidation of the hornblende and of all the other minerals of the rock, the earth stresses having produced plasticity in connection with the replacement of augite by hornblende.

The basic dykes, and a gabbro vein, east of the Lion Rock, Kynance Cove, are then described. The latter is so coarse that the name "gabbro-pegmatite" is proposed for rocks like it. Further east there is a wedge of granulitic rock, a type not previously noticed on the West coast. The granite type in this wedge occurs in puckered bands, streaks, and lenticles, the junction with the serpentine is wavy on the west, and the banding of the granulite is parallel to the junction, and on the east there is a tongue-like process of rotten serpentine intruding into the granulite. These phenomena are held to prove that the serpentine was not intruded into a *solid* granulitic complex, but either the granulite was intruded into the serpentine or they have been folded together while the granulite was plastic, or the serpentine (less probably) was intruded into plastic granulite.

***475. Preller, C. S. du Riche.—Note on a Coast Section at the Lizard.**

Geol. Mag., Dec. 3, vol. x. pp. 221, 222.

The author gives a rough figure of the mass of granite in serpentine near the Lion Rock, Kynance Cove, described by Messrs. Fox and Teall in No. **474**. The zigzag line of junction on the east side may be due to the intrusion of either rock into the other, and the author inclines to the view that the granite is the intruder, particularly because the tongue of serpentine is opposite a projection of granite on the west side.

476. Somervail, A.—On the Relations of the Rocks of the Lizard District.

Rep. Brit. Assoc. for 1892, p. 719.

Published in 1892 in the Geological Magazine [*see* No. **381**, 1892].

477. Clarke, Thos. — Paper and Sketch Map of Cornwall, showing the locality of the various Rocks possessing Power to Deflect the Magnetic Needle.

Journ. Roy. Inst. Cornwall, vol. ix. part ii. pp. 280–285, pl. xii.

The author has tested the proportion of magnetic material in certain rocks, as compared with that of Canna in Scotland, which is celebrated for its attractive power. The following are his results:—

	Weight in grains.	Reduction by magnet.	Percentage.
Botallack	289·7 ..	38·8 ..	13·4
Polyphant	241·5 ..	27·6 ..	11·4
Canna	278·8 ..	21·3 ..	7·6
Catacleus	201·5 ..	15·7 ..	6·7
Blackhead, Lizard ..	236·9 ..	14·3 ..	5·9

In experimenting it was found that the act of sawing the rock made it more magnetic for a time, and the author suggests that the friction of stones on the beach may have a like effect.

478. McMahon, C. A.—Notes on Dartmoor.

Quart. Journ. Geol. Soc., vol xlix. pp. 385–395.

The object of this paper is to show the impossibility of the views advocated by W. A. E. Ussher [No. **366**, 1892] as to the history of the granite of Dartmoor. The author first gives examples of intrusive veins passing from the granite into the surrounding slates. Such are seen in the course of the Lyd at 'Mary Emma,' and a little way off a granite dyke occurs in the slates. These veins are not to be distinguished under the microscope from the main mass. In the river Tavy, about a quarter of a mile above Hill Bridge, there is a reef of granite 8–10 yards wide, lying at a distance of 50 yards from the main mass. It is non-porphyritic and garnetiferous, like the edge of the adjacent granite. The dyke at Meldon is well known: it is 40 ft. wide, and strikes W.S.W. 10° W. Some of the leaves of mica are bent and the felspars broken, but the author nevertheless does not consider that the rock gives evidence of dynamometamorphism, accounting for these features either by the granite being forced through the jaws of a fissure in the slates, or by strains while the dyke was solidifying. Now the ground-mass of this dyke consists of a quartz-felspar mosaic

or is tesselated; hence the author concludes that the structure is not necessarily connected with dynamometamorphism, and cites a similar instance in the Himalayas. It is next argued that a squeeze which would fuse 225 square miles of rock ought to have had an effect also on the slates, whereas their metamorphism is considered to be of thermic and not of a dynamic origin, and ceases everywhere at a distance of one to one-and-a-half miles from the granite boundary; moreover, the dividing line between the granite and slate is always sharp, and the explanations of this proposed by Mr. Ussher are discussed and rejected.

Again, the heat at which the granite was "fused" was [too] great [to be produced, as Mr. Ussher supposes?]. This is shown by the large size of the vacant spaces in the cavities of the quartz compared with the area of the mineral [in microscopic section], which proves that the enclosed liquid had a greater solvent power at the time of its enclosure.

The epidiorites are not later than the granite, but are cut by elvans which radiate from the latter. The granite must, therefore, correspond in position with *some* eruptive mass. This rock is less poryphyritic at the edges, and the crystals are there eroded as in the ascent of a liquid magma into regions of less pressure.

The pseudo-bedding of the granite is parallel to the existing surface, showing quâ-quâ-versal dips round a hill, and being horizontal at the top. It is a structure, therefore, not of primary but of recent origin, and the author refers it to the action of sun and frost producing the alternations of temperature, which are well known to cause the flaking of rocks.

479. Ussher, W. A. S.—The Devon and Cornish Granites.

Rep. Brit. Assoc. for 1892, p. 709.

In this paper the author states the conclusions which he has more fully developed elsewhere [*see* No. **366**, 1892].

***480. Ross, A.—A visit to the Island of St. Kilda.**

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 72–91, with four plates. (Read in 1884.)

The first part of this paper deals with the geology. The main mass of the island is composed of granite, but there are also basic rocks. The granite is brown, and between Oscheval and Connaglier begins to change to gabbro, and for some distance there are fragments of basalt intermixed with the granite. "This would seem to indicate that the basalt may be earlier than the granite, and in one specimen a vein of the

latter appears to pierce the former." On the east side of Oscheval, however, there are basalt veins in the granite, and also dykes near the north landing-place; "but these may have been ejected at a later date." The acid rocks are coarse granite, fine granite, and quartz-felsite; the basic ones—gabbros, dolerites, and basalts. The junction specimens have been examined by Prof. Judd, who pronounces that "what appears to be granite to the eye, is seen under the microscope to be a quite different rock—a quartz-diorite; an intrusion of a similar quartz-diorite, probably later than the basalt, occurs also near Knock in the Isle of Mull." The other rocks show striking resemblances to those of Skye.

481. Horne, J., and Teall, J. J. H.—On Borolanite, an igneous rock intrusive in the Cambrian Limestone of Assynt and the Torridon Sandstone of Ross-shire.

Trans. Roy. Soc. Edinburgh, vol. xxxvii. pp. 163–178, with a plate [fig. 29].

FIG. 29.—Typical Borolanite from the N.W. slope of Cnoc-na-Sroine.

A bibliographical account of the study of the igneous rocks of the district dealt with commences this article. These igneous rocks are seen intruding along the bedding, principally between

Loch Assynt and Elphen, and between Glencoul and Allapool, on the two sides of the limits of the thrusts. The distribution of the intrusive mass of Cnoc-na-Sroine, Loch Borolan, and Ringhe Cnoc is then traced, from which it appears (1) that a zone of crystalline marble can be traced for long distances in immediate contact with or close to the eruptive rock; (2) that a gradual passage can be followed at certain localities from the marble into recognizable bands of Durness limestone; (3) that on the slopes of Sgonnan Mòr, and again at Cnoc-na Glas-Chorille, the intrusive mass is truncated by the main outcrop of the Ben More thrust-plane; (4) that in the neighbourhood of Ledmore, Ledbeg, and Logne, outliers of the materials overlying the Ben More thrust-plane cover portions of the intrusive rock and the altered Cambrian strata; (5) that from the apparent superposition of the marble along the eastern limit of the igneous mass, it is not improbable that the latter may resemble the other intrusive sills in Assynt, and may have been originally injected as a great sheet along the bedding planes. It is to the east of Loch Borolan that the igneous mass assumes that peculiar character for which the name Borolanite is proposed. The prevailing type of Borolanite is a medium-grained rock of dark grey colour, often with whitish patches of ellipsoidal form and of various sizes, and occasionally drawn out into streaks. The main constituents, independently of the patches, are orthoclase and black garnet (melanite), an association to which no name has been hitherto assigned. The orthoclase is fairly rich in soda, and has a specific gravity of 2·52; it forms a large proportion of the patches. The dominant form of the garnets is the rhombic dodecahedron [1, 1, 0], sometimes truncated by the icositetrahedron [2, 1, 1], and is brown in thin sections. There is also in the rock very occasionally plagioclase, black mica, and pyroxene; the last sometimes replaces the melanite and is green, with a more coloured margin in thin sections. Sphene occurs more occasionally in ophitic plates or in granules, also apatite and magnetite. Associated with the felspar is a turbid substance, sometimes in patches and sometimes micropegmatitically combined, occasionally showing hexagonal outlines. Treated with H Cl it swells, and the solution contains soda; hence it is concluded that it was originally nepheline. In some veins a blue alteration product after a mineral of the sodalite group is wedged between the orthoclase crystals. Wollastonite occurs at Sgonnan Mòr; it is observed by crushing the crystal into flakes. The light patches consist of orthoclase and the relics of the nepheline and sodalite; they are compared to the pseudo-leucites found in the rocks of Brazil.

Borolanite is a member of the Foyaite family. Its other occurrences are at Elphen, Corgach district of West Ross-shire

in Torridon Sandstone, where there is fresh nepheline and ægirine. An analysis of this rock by **J. H. Player** gives:—

Silica	47·8
Titanic acid	·7
Sulphuric acid	·4
Alumina	20·1
Ferric oxide	6·7
Ferrous oxide	·8
Manganic oxide	·5
Barytes	·8
Lime	5·4
Magnesia	1·1
Soda	5·5
Potash	7·1
Loss on ignition	2·4
	99·3

***482. Barrow, G.—On an Intrusion of Muscovite-Biotite Gneiss in the South-Eastern Highlands of Scotland, and its accompanying Metamorphism.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 330–356, pls. xv., xvi.

The district described is in the north-east of Forfarshire, between the head-waters of the North and South Esk. The foliated rocks are, in general terms, a foliated granite, of which there are six large and several smaller outcrops. The first mass to the west is mainly massive, but about the head of Glen Clova the sedimentary rocks are permeated by tongues or thin bands of it. This area the author calls the "permeation area." Here the "gneiss" is composed (in order of abundance) of quartz, felspar, muscovite, and biotite. The felspar is lenticular and mostly oligoclase, the polysynthetic twinning of which is only partial in a single crystal; there is no microcline and probably no orthoclase, and there are zircons and garnets but no apatite. The second mass is to the east of the first, and connected with it; the rock is less "foliated," and consists of quartz, plagioclase, a little orthoclase? two micas, and minor minerals as before. Pegmatite occurs throughout, and microcline begins to appear near the edges. The third mass, still more to the east, is very irregular in shape and of large size. The rock has the same order of abundance of the minerals, but there is more microcline than mica, especially towards the edges, while still closer to the edge microcline becomes the most abundant mineral; the quartz contains hairs and bubbles, and brown mica also disappears. The borders are pegmatitic, with a graphic structure in places. In the fourth mass, to the south, the rock has microcline for its dominant felspar.

Thus these intrusions become more "acid" towards the south-east, *i.e.* the plagioclase and biotite decrease in amount and the microcline increases, while the muscovite crystals

become larger. This is accounted for by the supposition that the earlier formed minerals were strained off as the still liquid potash-bearing material travelled in a south-easterly direction. It is believed also that the north-western portion must have had a higher initial temperature. The brown mica may be fairly classed as haughtonite, the white is typical muscovite, and there is also schorl in places.

The rocks into which these masses are intruded are highly crystalline, but towards the south-east they become finer in grain till they are phyllites. They may also be arranged in three zones, in which the rocks have developed respectively sillimanite, cyanite, and staurolite. The sillimanite occurs in two forms, the most abundant being found in "quartz sillimanitizé," where, in the centre of the quartz crystal, there is a snow-white patch, made up of needles becoming isolated towards the outside. These patches weather out on the surface of the rocks with a pearly lustre. The other mode of occurrence is in wavy threads like spun silk, massed in a film, except at the frayed-out ends. The cyanite also occurs in two forms, either singly or in aggregate. The single crystals are rounded at the sides and ends, but in this district are never twinned; they often have the colour of "black-lead," due to iron-ore inclusions. As it has been shown by Vernadsky that cyanite is converted into sillimanite at 1320°–1380° [C.?], the author concludes that the sillimanite zone must have at least this temperature. The staurolite zone is very continuous, and nearly coincides with a particular bed. The usual twinning of the mineral is modified by the crystals cutting each other at 60°. Most of the crystals decompose to a "shimmer" aggregate, which may be composed of scales of white mica embedded in some substance as hard as quartz.

The other minerals of these altered rocks are micas, which sometimes lie across the foliation planes, and in which sections parallel to the vertical axis show dark spots due to a core of iron ore or epidote with a pleochroic border; garnets which become very transparent as the granite is approached; quartz which breaks up into patches of different optical orientation; and felspar which is mostly oligoclase. As a whole the altered rocks are coarse felspathic gneisses in the north-west passing into two types, viz. a fine siliceous and a coarse sillimanite-bearing gneiss. There is also an impure quartzite, and a band of impure crystalline limestone containing green hornblende, zoisite, felspar, quartz, and sphene, and at one place microcline, a mineral not yet known elsewhere in the metamorphic rocks of the central highlands. The cyanite rocks, as a rule, are finer in grain, and consist of quartz and two micas, and some have been originally the same rock as the sillimanite-bearing ones have been derived from. The best crystals of cyanite are found in Glen Effoch, where they are dotted with ilmenite, and

on Bulg, where they aggregate to the size of a man's head. In this zone also there are gneisses, quartzites, and grits. The staurolite rocks are mostly fine sericite schists, but in places contain brown and white mica and quartz with garnets. Further from the intrusions grits come on which are markedly clastic, and there is a band of quartzite with green mica which passes from the cyanite into the staurolite zone, and the adjacent schist does the same. Further away still come pebbly grits and phyllites.

That these rocks were originally sediments is in many cases obvious, *e.g.* the staurolite schists contain too much alumina and the green mica quartzite too much silica to be anything else.

The largeness of the area affected by the metamorphism is explained by the proximity of the igneous rocks to the surface. In certain sills they are seen to be horizontal, and bosses of pegmatite dot over the sillimanite zone. The various amounts of metamorphism must be in relation to the various depths at which the igneous rocks lie below the surface, and this is to a great extent determined by the amount of folding to which they had been subjected before the intrusion of the granite; this folding in the major folds may reach a depth of 2000 ft. The older rocks exposed are naturally more metamorphosed than the younger, but as a rule the metamorphism has no direct relation to the age, but to the depth at which they lie.

Analyses are given of: (A, B) the brown and white mica, of the igneous rock; (C, D) the brown and white mica, of contact-metamorphism; (E) the phyllite north of the great fault; and (F) the staurolite schist north of Bulg.

	A.	B.	C.	D.	E.	F.
SiO_2	34·90	43·08	35·00	45·80	58·00	39·70
Al_2O_3	23·27	32·85	25·06	31·84	20·16	36·40
FeO	20·87	2·76	15·30	—	—	—
Fe_2O_3	2·56	·73	3·94	5·86	7·64	9·60
CaO	1·20	1·07	1·50	tr.	·73	1·20
MgO	4·32	·33	6·48	1·15	2·49	3·20
K_2O	6·94	8·78	9·31	7·56	3·91	3·60
Na_2O	2·01	1·00	1·84	3·19	3·41	2·58
Loss	3·60	9·12	1·72	4·90	3·03	4·50
	99·67	99·72	100·15	100·30	99·37	100·78

483. Aitken, Dr.—Excursion to Abriachan.

Trans. Inverness Sci. Soc. and F. C., vol. iii. pp. 172–179. (Read in 1886.)

The granite here is intrusive, and in relation to this the general origin of granite is discussed, and arguments in favour of water being concerned in the matter are brought forward. The diorite of Glen Urquhart is also noticed, the author

remarking that it becomes more compact and even schistose at the margins.

484. Hatch, J. H.—The Lower Carboniferous Volcanic Rocks of East Lothian (Garlton Hills).

Trans. Roy. Soc. Edinburgh, vol. xxxvii. pp. 115–126.

The rocks here described are partly lava-flows and partly necks. Of the lavas there are basic types below and trachytic types above. In the former series there is a progression in which the magnesia decreases as the silica increases. The rock of Whitelaw Hill is a limburgite—now for the first time recognized in Britain, but it is stated in a note that the same type of rock occurs at the Hill of Beith, Cowdenbeath; Pitandrew, Fordel Castle; and Southdean Law, Jedburgh. This limburgite is free from felspar and consists of olivine, augite, and magnetite. The olivine is mostly unaltered, and the augite has a pale claret colour. The larger crystals lie in a ground-mass of augite needles and interstitial glass, powdered with a yellowish dust, and in places there are indications of nepheline. The analysis by **J. H. Player** is given below as A.

Kipple Law is composed of olivine basalt. Porphyritic felspar and olivine lie in a ground-mass of lath-shaped felspars, granular olivine, magnetite, and microlitic augite. Almost all the constituents are idiomorphic, particularly the last named. The analysis by **J. S. Grant-Wilson** is given below as B.

Hailes Castle is composed of olivine basalt of a more felspathic character. Limonitic pseudomorphs after olivine and glomeroporphyritic crystals of striped felspar lie in a ground-mass of microlites and laths of felspar, with granules of augite and magnetite. The analysis by **J. S. Grant-Wilson** is given below as C.

Markle Quarry yields labradorite basalt, which is more felspathic still, and olivine occurs only in small sporadic grains; the felspar is plagioclastic and porphyritic, and the ground-mass is similar to the last. The analysis by **J. S. Grant-Wilson** is given below as D.

	A.	B.	C.	D.
Silica	40·2	46·01	49·07	49·54
Titanic oxide	2·9	—	—	—
Alumina	12·8	19·19	19·43	22·23
Ferric oxide	4·0	5·91	10·58	9·55
Ferrous oxide	10·4	6·75	2·35	1·12
Manganous oxide	—	·19	·32	·08
Lime	10·4	8·68	7·87	7·19
Magnesia	11·9	6·81	4·36	2·80
Potash	·8	1·20	·98	1·81
Soda	2·7	3·27	3·31	4·56
Water and loss	3·4	3·07	2·26	2·42
	99·5	101·08	100·53	101·30
Spec grav.	3·03	2·8	2·76	2·7

The trachytic lavas are partly porphyritic with clear unstriped felspars, largest at Peppercraig and smallest at Hopetoun Monument; the ground-mass is also mostly felspar, with a little augite and magnetite, and is completely crystalline. The porphyritic felspar is remarkably clear sanidine, with a tendency towards glomeration, in which case the constituents are only idiomorphic on the outside towards the surrounding matrix, in which there is often some microfluidal structure. The non-porphyritic types consist of interlaced laths of untwinned felspar with powdery carbonate, which is partly pseudomorphous after augite. Here, too, the ground-mass is holocrystalline. The analysis of the rock from Peppercraig, by **J. S. Grant-Wilson,** is given below as A; of that from Hopetoun Monument, by **G. Barrow,** as B; of that from Kae Heughs, by **J. S. Grant-Wilson,** as C; of those from Phantassie and Bangley Quarry, by **A. Dick, Jun.,** as D and E.

	A.	B.	C.	D.	E.
Silica	62·61	62·50	61·35	59·50	58·50
Alumina	18·17	18·51	16·88	18·25	21·12
Ferric oxide	0·32	4·39	·41	4·81	4·68
Ferrous oxide	4·25		5·01	2·34	—
Manganous oxide	·21	—	·26	—	—
Lime	2·58	2·00	2·39	2·10	3·70
Magnesia	·74	·61	·44	·70	·93
Potash	4·02	6·31	6·12	6·30	5·84
Water	6·49	3·44	5·26	5·03	3·90
Loss on ignition	·80	2·10	1·70	1·60	2·00
	100·19	99·86	99·82	100·63	100·67
Spec. grav.	2·6	—	2·6	—	—

Volcanic vents occur near Dunbar, as an olivine basalt at the Castle, and an intrusive limburgite at Gen Head Tantallon, but the principal necks are the following:—

North Berwick Law.—This is composed of a trachyte, consisting of a plexus of long lath-shaped sanidine in finer spicules of the same. The analysis by **J. S. Grant-Wilson** is given below as A.

The Bass rock is also a trachyte similar to the last and non-porphyritic. The analysis by **G. Barrow** is given below as B.

Traprain Law is composed of phonolite. The rock mainly consists of small lath-shaped sanidine, somewhat fluidally arranged, but not porphyritic, and there is a bright green soda-augite. In parts there is a brown dust, in which may be detected small patches of nepheline, which occasionally show six or four-sided contours, but are often changed to zeolites; they are certainly soda-bearing. The analysis by **J. H. Player** is given below as C.

	A.	B.	C.
Silica	60·15	57·50	56·8
Titanic acid	—	—	·5
Alumina	18·04	18·89	19·7
Ferric oxide	4·44	7·51	2·2
Ferrous oxide	1·82		3·5
Manganous oxide	·13	—	·2
Lime	1·68	1·80	2·2
Magnesia	·98	1·33	·4
Potash	4·15	5·90	7·1
Soda	6·07	5·71	4·3
Water or loss	2·06	1·70	2·5
	99·52	100·34	99·4
Spec. grav.	2·46	—	2·588

***485. Johnston-Lavis, H. J.—On the occurrence of Pisolitic Tuff in the Pentlands.**

Rep. Brit. Assoc. for 1892, p. 726.

In certain tuffs of Old Red Sandstone age between Camethy and Scald Law, marked as rhyolite on the Survey Map, the author observed some pisolites. These, he states, "have been shown to be produced by drops of rain falling through a dirty atmosphere," which collects the larger particles first and later the finer dust. Their presence he considers to indicate that the eruptions were either subaerial or in very shallow water, and also to prove the similarity of the conditions prevailing in those ancient times to those of the present day.

***486. Judd, J. W.—On Composite Dykes in Arran.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 536–564.

Composite dykes may be divided into two categories: those "in which a differentiation has gone on in the material that has filled the dyke; and those" in which there has been an injection of different materials into the same fissure.

Attention is called to the composite dykes of the first class described by A. C. Lawson on the Rainy Lake District of Canada, and by J. H. L. Vogt in Norway, both of which are said to show more acid margins, and different minerals in the centre. The dykes of Arran, however, belong to the second class. They are the products of the latest phase of volcanic action in the British Isles, when actual eruption was very limited, but the fissures were filled by two types of material, viz. the augite-andesites of the North of England dykes, and the pitchstones of the Western Isles. The latter, in many cases, being rich in soda, may be classed with the pantellerites.

The first composite dyke to be noticed is that of Cir Mhor, which runs from near the summit towards Goat Fell, and which has been described by Ramsay and Bryce. The outside, whose

analysis by **J. A. Schofield** is given as A, is an augite-porphyry; the inside, whose analysis by **E. C. Thompson** is given as C, is a pitchstone porphyry; and the intervening band on either side, whose analysis by **J. A. Schofield** is given as B, is a quartz-felsite.

	A.	B.	C.
Silica	55·79	75·31	72·37
Alumina	15·97	13·62	11·64
Ferric oxide	12·50	2·31	1·42
Ferrous oxide	—	—	1·08
Lime	7·06	0·97	1·30
Magnesia	2·22	0·20	0·52
Soda	2·21	3·02	4·15
Potash	1·86	4·07	3·98
Sulphur	0·45	tr.	—
Water and loss	2·43	1·48	4·86
	100·49	100·98	101·32
Spec. grav.	2·70–2·71	2·52–2·53	2·36–2·37

A is therefore a distinct rock, but B may be derived from C by devitrification.

The ground-mass of the andesite is a microlitic felt, showing intersertal, and occasionally ophitic structure. The porphyritic felspars are of soda-lime, more basic towards the centre of the crystal and showing alternations of corrosion and growth. The ground-mass has plagioclase laths, perhaps also orthoclase, augite, magnetite, etc. The glassy part "often forms irregular nests in the midst of the rock, but where, as sometimes occurs, there are steam holes in the rock, these become filled with the easily separated glass."

The pitchstone porphyry is for the most part glassy, with the usual skeleton crystals; the porphyritic constituents are quartz, an orthoclase, and augite. Round these, or at their angles, are seen concentric coats of clear material, which shows negative double refraction and crosses, etc., due to strain; the inner coat is bounded by a layer of overlapping crystals of tridymite, and there are radial crystals of hornblende down to ultra-microscopic size. The clear material has a refractive index indistinguishable from that of the surrounding glass, but as it is acted upon by caustic potash, and is very slowly stained by fuchsine, it is considered to be hyalite. The "hornstone" boundary and the felsite only differ from the above in being devitrified, *i.e.* the same porphyritic constituents are present, and the author considers the devitrification to have taken place at the time of the original consolidation.

Another area where such composite dykes are developed is on the Tormore coast on the western side of the island, where they have been described by Jameson, Allport, and Zirkel. The main dyke, which runs parallel to the shore,

consists of a centre of pitchstone, bounded on either side by spherulitic felsite, and beyond this on one of the outer sides there is a thin band of augite-andesite of later date. This is crossed by three transverse dykes: the first has quartz-felsite in the centre, and is bounded on either side by augite-andesite, and obliquely across both runs a narrower dyke of pitchstone porphyry of later date. The latter shows the peculiar phenomenon, which has been observed in a glass from Ponza, of breaking into spheroids, which very soon lose their vitreous lustre, the fractured surfaces becoming covered with a whitish film, due to a rearrangement of the surface molecules on their release from strain. The second transverse dyke is 40×50 ft. wide, and is mostly composed of augite-andesite, but near the centre there is a band of quartz-felsite with a vitrophyric centre. The third, which lies to the south, consists mostly of quartz-felsite with very large porphyritic crystals, and has narrow augite-andesite dykes at the side and obliquely near the centre. The already published analyses of these rocks are quoted. The andesites are of the ordinary character; the acid rocks in the north and south running dyke has only plagioclase crystals, but in the two northern transverse dykes quartz is added, with coats of hyalite, and in the third orthoclase takes the place of the plagioclase. Besides these authigenetic crystals the acid rocks contain corroded crystals derived from the basic rocks, while more frequently the quartz of the acid rock is found in the basic surrounded by a coat of pyroxene.

The author considers that the later eruptions have taken place from the same magma, along lines of weakness in the earlier ones. Sometimes the order is acid-basic, at other times basic-acid. As the two types are so distinct the differentiation must have taken place before the work of crystallization had commenced. As to the process by which this is effected, it is pointed out that the action of the principles enunciated by Gouy and Chaperon, and by Van t'Hoff and Soret respectively, would operate in contrary directions and tend to neutralize each other.

487. Ede, H. E.—"Composite" Dykes.

Nature, vol. xlix. pp. 77, 78.

Refers to examples of this kind of thing at Cligga Head, Truro.

***488. Judd, J. W.—On Inclusions of Tertiary Granite on the Cuillin Hills, Skye; and on the Products resulting from the Partial Fusion of the Acid by the Basic Rock.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 175–194, plates ii., iii.

The author first draws attention to a specimen in his cabinet of a quartz porphyry from Ascherhübel, Saxony, which has been

remelted by an outburst of basalt, and which now shows, in consequence, spherulitic and perlitic structures.

The granite of Skye becomes, towards its edges, drusy and micropegmatitic, and in turn becomes an ordinary quartz-felsite. At Druim-an-Eidhne, in the Cuillin Hills, the junction of granite and gabbro is well seen, and though the latter has many segregation veins [of more acid material] none enter it from the granite; but at some distance from the boundary line, within the gabbro area, there are a number of irregular isolated patches [several square yards in area] of pale granitic rock, which weathers into hollows. The rock of the patches presents a very different appearance from that of the normal granite, and, in fact, has more the aspect of a rhyolite. It is compact, splintery, sometimes almost glassy, and has parallel bands of spherulites, which are of the size of a small orange.

Under the microscope this rock is found to contain crystals of quartz, felspar, and magnetite in a more or less devitrified ground-mass. The quartz is sometimes finely cracked, with glass intruded into the cracks. Some is idiomorphic, and some allotriomorphic; in the former the cavities contain glass, in the latter bubble-bearing liquid. In some cases zones of secondary [pyrogen] quartz are formed round corroded fragments. The felspars are almost always kaolinized, and more or less opaque; they are often cracked, with the cracks filled by secondary felspar; occasionally the centre of the crystal has been fused and devitrified. Both of these minerals are sometimes surrounded by radiating limonite trichites. The pyroxenic constituent has most been broken up.

The spherulites of the ground-mass may attain a diameter of 2½ inches, and they are often composite, *i.e.* spherulites within a spherulite, the inner ones being of the compact or pseudo-spherulitic type. In other cases the plume or brush-like sectors are separate towards the centre, forming "porous spherulites." These plumes are of two colours, the one blue-grey with disseminated pyrites, the other creamy-white, consisting only of felspar and quartz separated by limonite. Some of the spherulites have a nucleus of micropegmatitic granite, not entirely dissolved. Hollow spherulites or lithophyses abound, and the mass is sometimes made up of crushed and distorted spherulitic growths, indicating that it "was subject to internal movement during the time that the spherulites were being formed." In these acid rocks pyrites and possibly also altered fayalite are found.

The above observations the author considers to afford indisputable evidence that the masses dealt with are inclusions of the granite in the gabbro, which have been altered by it, and that in consequence the gabbro must be the younger rock. He also states that the veins which come from the granite pierce, not the gabbro, as supposed, but the altered andesites.

489. Goodchild, J. G.—On a Granite Junction in Mull.

Rep. Brit. Assoc. for 1892, p. 722.

Published in 1892 in the Geological Magazine [*see* No. 376, 1892].

***490. Sollas, W. J.—On the Origin of Intermediate Varieties of Igneous Rocks by Intrusion and Admixture, as observed at Barnavave, Carlingford.**

Geol. Mag., Dec. 3, vol. x. pp. 551, 552. (Read at Brit. Assoc.)

At Barnavave an almost black gabbro is associated with an almost white granophyre; the former, which lies uppermost, is the older, and is intruded into by the latter in such a way as to enter into the minutest cracks between the minerals, and thus produce a quartz-gabbro. The granophyre also contains fragments of the gabbro, varying in size from great blocks down to mere dust, thus producing the hornblendic granophyre or syenite of the maps. This case is, therefore, not one of differentiation from one original magma.

***491. Watts, W. W.—Notes on the Perlitic Quartz Grains in Rhyolite.**

Geol. Mag., Dec. 3, vol. x. pp. 580, 581. (Read at Brit. Assoc.)

The rock referred to is the Sandy Braes rhyolite from county Antrim. It shows crystals of sanidine and quartz embedded in a brown glass. The glass is perlitic, and so is the quartz; in one case a crack passes from one to the other.

***492. Sollas, W. J.—On the Variolite and Associated Igneous Rocks of Roundhead, co. Wicklow.**

Sci. Proc. Roy. Dublin Soc., vol. viii. pp. 94–115.

The variolite of Roundwood forms part of an igneous complex which includes diabase, spilite, and consolidated volcanic tuff. The complex is exposed in a series of isolated hummocks on the marshy ground on either side of the road from Roundwood to Glendalough. The greenstone on the right-hand side of the road is a holocrystalline ophitic diabase, in which the augite is largely decomposed into chlorite, the felspar invaded by the same, and the ilmenite converted into leucoxene. The hummocks on the right [? left] hand side consist of a dark, brownish-red, felsitic-looking rock with a platy structure, the more coarsely crystalline variety being vesicular. From this rock with its intersertal structure and slight traces of original glass, up to the completely variolitic modifications, there is every stage of transition, affording a complete passage from the variolites "du Drac" to those

"of the Durance." The slaty structure is due to a number of lines of cleavage, showing shifting by the dislocation of the felspar crystals. The vareoles often have a felspar crystal as a nucleus, the radii twisting round like magnetic lines. Some show a clearer centre, supposed to be due to decomposition and development of silica. There are also scattered crystals of olivine, now pseudomorphosed, and many fissures of retreat.

The following are analyses of the red (A) and green (B) varieties respectively:—

	A.	B.
Silica	42·52	37·97
Titanic acid	·89	·92
Alumina	18·10	19·45
Ferrous oxide	7·50	7·85
Ferric oxide	4·12	2·95
Lime	6·07	18·25
Magnesia	8·55	4·58
Potash	·56	tr.
Soda	4·33	2·90
Water	6·86	2·71
Carbon dioxide	tr.	2·58
	99·50	100·16
Spec. grav.	2·94	3·01

The fissures in some of the epidote crystals are so numerous as to suggest that there must have been a contraction of material during alteration, as from anorthite to zoisite, the molecular volume of the latter being only ·89 that of the former. Chloritic minerals, on the other hand, indicate expansion.

A long discussion follows on this change of volume, and in this connection the origin of serpentine is discussed. We are told that it may be derived either from olivine or enstatite. In the first case the equation given is—

$$2\,\mathrm{Si}\,(\mathrm{O_2\,Mg})_2 + 2\,\mathrm{OH_2} = \mathrm{Si_2}\,(\mathrm{O_2\,Mg})_2\,(\mathrm{OH})_4 + \mathrm{Mg\,O}.$$

The molecular volume of olivine is 85 and that of serpentine 115: "thus, disregarding the molecule of magnesia, the conversion of olivine into serpentine is accompanied by an increase in volume amounting to nearly 30 per cent." [*cf.* No. **581**, 1890, where the equation and results are very different]. A similar equation is given for the conversion of enstatite, involving the setting free of silica and an increase of volume of 13·6 per cent. If the two decompositions take place in the same rock the silica and magnesia will produce more serpentine, and the total increase of volume will reach 40 per cent. Similarly the production of chlorite from pyroxene represents a loss or a gain of volume according as we omit or take into account the silica set free. The simultaneous production of these minerals in a rock suggests that the source of the materials of a chloritic schist may be from the weathering of pyroxenic rocks. The

results as to volume of the [apparently spontaneous] decomposition of other minerals is also discussed.

***493. Watts, W. W.—Notes on a Hornblende-Picrite from Greystones, co. Wicklow.**

Geol. Mag., Dec. 3, vol. x. p. 550. (Read at Brit. Assoc.)

The rock noted is a " dyke in the Cambrian Slates," and has a lustre-mottled surface due to the large crystals of hornblende. There are three types of hornblende—green, colourless, and dusty.

***494. Sollas, W. J.—On Pitchstone and Andesite from Tertiary Dykes, in Donegal.**

Sci. Proc. Roy. Dublin Soc., vol. viii. pp. 87–93.

The specimens are from Barnesmore Gap, and were described and analysed by Dr. Haughton in 1857, but they are now examined microscopically. The pitchstone has a close resemblance to that of Arran, but differs from it by the presence of groups of small stellate crystallites, especially in the selvedge. The crystals which have the microscopical characters of augite were shown by Dr. Haughton to contain no magnesia; the variety is, therefore, probably hedenbergite. The andesite is a typical augite-andesite with infilled vesicles: as there is no sign of devitrification, it cannot well be older than Tertiary.

***495. Watts, W. W.—On Some Limerick Traps.**

Rep. Brit. Assoc. for 1892, p. 727.

The earliest Carboniferous eruptions were of porphyritic lava and ash, and were followed, after an interval of sedimentation, by eruptions of basaltic lava and ash, and at a later date, or connected with the foregoing eruptions, there were intrusive porphyrite and quartz-porphyrite. The latest of the lavas is a limburgite, with large crystals of augite and pseudomorphs of olivine in a fine-grained base of augite and magnetite.

496. Bonney, T. G., and Raisin, Catherine A.—On the so-called "Spilites" of Jersey.

Geol. Mag., Dec. 3, vol. x. pp. 59–64.

These "spilites" were considered by M. Noury to be metamorphosed argillites, but Prof. Lapparent has since called them porphyrites [*see* No. **379**, 1892]. They occur in the Mont de l'Ouest, near St. Heliers; some are amygdaloid, and others suggest flow-brecciation. A section is given showing a breccia of " spilite " at the base, followed by a band of argillite and fine grit, and this is overlain by amygdaloidal and

porphyritic "spilite." The first is considered to be an agglomerate. The structure of the massive rocks shows lath-shaped felspars and other minerals, which are described in detail. The spec. grav. is 2·78, and the reference to porphyrite is confirmed. The "chloritoschiste" of M. Noury has dimorphic felspars, and others, possibly pyroxenic, porphyritic crystals. Its spec. grav. is 2·74, and it is concluded that this also is a rather basic porphyrite.

497. Hill, E. — On Mica-Trap Dykes in the Channel Islands.

Rep. and Trans., 1891, Guernsey Soc. Nat. Sci. and Local Research, pp. 152–154.

The author enumerates those up to this time known to him; they include several in Jersey, one in Alderney at Mannez Quarry, one on the east side of Jethow, none in Herm, one in Port du Moulin, Sark, and others in Saignée Bay, Goulier Caves, Havre Gosselin, and Conpee, and one in Guernsey at Point Norman.

METAMORPHISM.

***498. Barrow, G. — On the Origin of the Crystalline Schists.**

Proc. Geol. Assoc., vol. xiii. pp. 48, 49.

Specimens were shown which exhibited parallel structure alone and crystallization alone, and both together, thus showing the independence of these two characters. Crystallization was shown to be brought about by contact with igneous rock, and the effects thus produced are increased by pressure forcing a greater mass on to the top, so as to bring the rocks into places of higher temperature. "Thus the schists result from the combined effects of earth movements and heat."

***499. Harker, A., and Marr, J. E.—Supplementary Notes on the Metamorphic Rocks around the Shap Granite.**

Quart. Journ. Geol. Soc., vol. xli. pp. 359–371, plate xvii. [In the observations to which these are supplementary, *see* No. **413**, 1891.]

The authors now find that much of the ground north of Shap Fell is occupied by basic igneous rocks, which, although destitute of olivine, may be called basalts. They contain amygdules, and had been weathered and cleaved before they were subjected to thermo-metamorphism. The first sign of the

latter change is seen at 1150–1200 yards from the granite in the production of flakes of brown mica or green hornblende, according as they originally contained less or more lime; the associated ash containing less lime have more mica. There is also a colourless pyroxene in the altered basic lavas, and undoubtedly newly formed epidote in the vesicles; sphene and iron ores also occur. In the most altered portions, the matrix and some of the felspar are changed into a transparent mosaic. In the smallest vesicles, quartz predominates; in those a little larger there is hornblende; those of 2 in. diameter often have concentric shells, the outer, paler portions being of quartz and epidote, the more interior dark hornblende and pyrites, and in the centre some recrystallized calcite; while the largest of all contain deep-brown garnets in groups, showing zones of growth, and in some cases, not including the darkest, double refraction. The order of production of these minerals in time is as follows: iron ores, garnet, sphene, augite, green hornblende and actinolite, epidote, quartz, and calcite. The actinolite occurs as isolated reeds in the augite, or projects into epidote and calcite. The felspars may have been formed without the special aid of heat, in which case, the lime being extracted by them, brown mica is the accompaniment.

Some altered beds of slate, not yet detected *in situ*, are now considered to belong to the *convolutus* zone, having yielded characteristic fossils, and calcareous sands are associated with them in Wansdale Beck, some of which are seen to have been dolomitized, and others appear to have been so before metamorphism. When these limestones are pure, the calcite has simply recrystallized, but when any silica was present lime silicates are produced. In the nodular forms the aggregations of these crystals are surrounded by a sheath of felspar.

With the obvious exception of the elimination of water and carbonic acid it does not appear that the thermo-metamorphism has produced any change in the total *chemical* composition. What, then, is the range within which change in *mineral* composition is possible? This question is most easily answered in the case of the lime silicates. It is found that calcite is never preserved in vesicles of less than $\frac{1}{4}$ inch. This is the maximum distance within which lime silicates can be produced, and the calcite and quartz crystallize independently at distances greater than $\frac{1}{20}$ inch. In the nodules also of the Silurian Slates, calcite is found in the centre, with a border of only $\frac{1}{20}$–$\frac{1}{15}$ inch. The spots in the slates, which are free from brown mica, are less than $\frac{1}{20}$ inch in diameter. This, therefore, appears to be the diameter within which interchanges may take place.

The following is a complete list of the "metamorphic minerals" of the district in—1, basic lavas and ashes; 2, inter-

mediate ditto; 3, acid ditto; 4, calcareous; and 5, argillaceous rocks:—

Quartz, 1–5.
Orthoclase, 2–5.
Plagioclase, 1–5.
White mica, 3, 5.
Brown mica, 1–5.
Chlorite, 1, 5.
Tremolite, 4, 5.
Actinolite, 1, 2.
Green hornblende, 1–3.
Wollastonite, 4.
Lime augite, 1, 4.
Epidote, 1, 2.
Idocrase, 4.
Lime garnet, 1, 4.
Common garnet, 5.
Tourmaline, 3, 5.
Sphene, 1, 2, 4.
Rutile, 3.
Anatase, 5.
Ilmenite, 1, 3, 5.
Magnetite, 1–5.
Pyrite, 1–5.
Pyrrhotite, 1–5.
Apatite, 2, 3.
Andalusite, 3, 5.
Cyanite, 3.
Sillimanite, 3.
Calcite, 1, 4.
Dolomite, 1, 4.
Graphite, 5.

***500. Callaway, C.—The Origin of the Crystalline Schists of the Malvern Hills.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 398–423.

The author first quotes the writers who have affirmed the production of new minerals by dynamo-metamorphism, including the production of biotite out of chlorite, or out of chlorite and sericite, and of muscovite out of biotite. The two stages of metamorphism are: 1, decomposition and corrosion, the latter of which is seen in the hornblendes and felspars; 2, the reconstruction which has obliterated the former signs of strain. The different schists are then described as:—

A. *Simple schists.*—Those here described are all considered to have been formed from diorite or granite. The first stage is the production of hornblende gneiss, by the rearrangement of the constituents and the generation of quartz. The next stage is represented by biotite-hornblende gneiss, in which biotite has just begun to appear, associated with a little chlorite, and with felspar and quartz moulded upon it. Running parallel to the foliation of such gneisses are a number of cracks, and it is thought that the mica has been formed by the action upon the hornblende of the material brought in these. The mica was not there from the first, as it is not torn or distorted. The third stage is the muscovite-chlorite gneiss, described by the author in 1889.

A long description is given of the sericite and muscovite gneiss seen in the southern spur of Ragged Stone Hill, where the changes by which it has been produced are said to be traceable in the field. The first slide described shows crushed hornblende, of which some is changed to chlorite; also epidote, minute flakes of secondary muscovite, a little quartz, and much calcite. The felspar is moulded on the crushed hornblende, and is therefore clearly secondary. A slide from a rock a few

feet away from this shows a little foliation; the hornblende has disappeared, and fragments of calcite, epidote, and felspar are scattered in a ground-mass of chlorite; the cracks are filled with decomposition products. The rock from three to four yards further up shows more marked parallelism in the elements, and chlorite has begun to change into biotite, while some of the cracks are margined with mica, and some of the felspar has changed to quartz. The rock three yards further west shows a groundwork of opaque matter and microscopic biotite, while the felspar is in smaller fragments, and there is much indeterminate matter which the author calls quartz-felspar.

A little further west reconstruction commences. Thus in a slide from the ridge north of the quarry "the hornblende is represented in great part by chlorite with granules lying in the direction of schistosity"; there is a little white mica, and a quartz-felspar mosaic, which on account of its foreign inclusions and coalescence of the original fragments must have been more or less fused or dissolved. This rock passes *gradatim* within two feet into the next, which shows well-marked parallelism with several lines of minute opaque granules; it consists of quartz-felspar with rounded outlines, moulded on equal quantities of chlorite and white mica, the one passing into the other in a single crystal. In places the chlorite disappears, and sericite only is left. The calcite which occurs herein is considered to have been there previously to the formation of the mica, because the veins of it are shifted where the quartz and mica join, and longitudinal lenticles of it are bounded by mica. Another series of slides shows chlorite passing into biotite, and this into fibrous white mica, and the felspar is replaced by zoisite? Another slide shows grit passing into schist. This group is called biotite-gneiss, or biotite granite, which "there can be no question have formed from the diorite," as the gradations between the two are numberless.

B. *Injection schists.*—These are divided into primary and secondary. The former group includes duplex-diorite-gneiss; granite-diorite-gneiss passing into a true mica-gneiss; banded biotite-gneiss, which is seen in the quarry south of Swinyard Hill to be produced from decomposed diorite by the injection of granite veins and gneiss with two micas. Included in this group is a gneissoid quartzite, in which biotite and muscovite have almost disappeared, and the dull felspar crystals are left invaded or replaced by quartz-felspar, and there is little parallelism in the structure. In confirmation of the origin of this quartzite the author quotes with approval a statement by W. S. Bayley, that in Minnesota there is a quartzite which has been derived by complete alteration from a gabbro. Of the latter group of injection schists very little is said, as they have already been described by the author in Q.J.G.S., 1889, pp. 496–497.

The structure of the Malvern schists cannot be always relied upon to indicate their derivation, *e.g.* the sericite schists of Ragged Stone Hill are, in some cases, formed from diorite, and in others from felsite. The author's shear-planes [he does not here say "shear-zones"] are those along which the mass has given way when moving in a solid state. No evidence is found of a mixture of magmas.

In illustration of the chemical changes supposed to be introduced in these conversions of one rock into another, several chemical analyses are given, viz. (I.) coarse grey diorite; (II.) crushed ditto; (III.) grit, just before it passes into schist; (IV.) sericite gneiss. They are by **J. H. Player.**

	I.	II.	III.	IV.
Silica	47·6	49·0	52·8	61·6
Alumina	17·6	19·0	15·8	18·6
Titanic oxide	1·6	1·2	2·6	·8
Ferric oxide	4·8	3·4	5·4	1·3
Ferrous oxide	5·8	7·5	9·5	5·1
Lime	8·6	2·8	·5	·2
Magnesia	5·0	5·3	4·1	2·6
Soda	2·3	2·0	1·3	1·6
Potash	4·3	2·5	1·9	3·7
Loss	2·2	6·5	5·7	3·7
	99·8	99·2	99·6	99·2

Other analyses of IV., by **Dr. Cohen,** gives silica 64·96 and 73·13. Thus the silica rises in steps, while the lime and magnesia fall.

A second set of analyses, also by **J. H. Player,** are of (V.) medium black diorite, Swinyards Hill; (VI.) basic rock; (VII.) biotite-gneiss traced *gradatim* into V.; (VIII.) gneissoid quartzite, Swinyards Hill.

	V.	VI.	VII.	VIII.
Silica	47·1	47·2	66·0	81·9
Alumina	18·1	17·8	16·6	9·2
Titanic oxide	·4	·4	—	tr.
Ferric oxide	3·0	6·7	1·6	·6
Ferrous oxide	8·5	5·6	4·2	1·6
Manganic oxide	·1	—	—	—
Lime	6·6	4·8	·5	.9
Magnesia	7·3	6·3	1·9	·5
Soda	2·4	2·2	1·5	1·6
Potash	2·8	3·9	5·3	2·1
Loss	3·6	4·1	2·2	1·1
	99·9	99·0	99·8	99·5

Three other analyses, by **T. H. Waller,** illustrate the loss of alumina in the final stages. They are (IX.) biotite gneiss,

Swinyards Hill; (X.) another example from the same locality; (XI.) gneissoid quartzite passing into X.

	IX.	X.	XI.
Silica	60·4	65·7	77·1
Alumina	18·6	17·2	10·9
Ferric oxide	3·5	·9	·7
Ferrous oxide	5·3	4·5	2·3
Lime	1·6	1·2	1·3
Magnesia	2·8	1·9	1·4
Soda	4·1	3·9	1·6
Potash	3·0	2·6	1·8
Loss	—	2·3	1·5
	99·3	100·2	98·6

The microscopic evidence shows that the loss of alumina is due to its elimination, but what becomes of it the author cannot say. The iron oxides are also seen to diminish.

The author finally gives a general summary of the results of his researches on this district under 12 heads. He says that all Malvern schists are derived from Plutonic rocks, the conversion being due to pressure on certain shear-zones. Most of them were solid at the time, but were partially fused during metamorphism. A crushed diorite in its transformation to a mica-gneiss passes through a laminated grit stage.

501. Irving, A.—Malvern Crystallines.

Rep. Brit. Assoc. for 1892, pp. 709, 710.

Published in 1892 in the Geol. Mag. [*see* No. **382**, 1892].

***502. Irving, A.—The Malvern Crystallines.**

Geol. Mag., Dec. 3, vol. x. pp. 92, 93.

Corrects supposed misconceptions of No. **382**, 1892.

***503. Callaway, C.—On the Conversion of Chlorite into Biotite in Rock-Metamorphism.**

Geol. Mag., Dec. 3, vol. x. pp. 535–538.

In reply to objections, the author points out that Lossen, Michel-Levy, Salomon, and Rüdermann have, like himself, asserted the change of chlorite into biotite, and he then proceeds to show how the necessary chemical change may be effected. The increased proportions of silica and iron oxide come from the decomposition of the diorite; in fact, biotite is seen surrounding blotches of iron oxide as a pleochroic halo in the midst of the chlorite. The increase of the potash from 0 to 8 per cent. may come in part from the decomposition of the felspar, the bulk analysis of the diorite containing from 2·5 to 4·3 per cent. of potash. In the neighbourhood of the

granite veins it may also come from them, for the percentage there rises from 2·8 to 5·3. The loss of magnesia is shown to occur in the whole rock, because while the uncrushed diorite contains 5 per cent. and the crushed 5·3, the micaceo-chloritic grit contains only 4·1 and the sericite gneiss 2·1; and in another case there is 7·3 per cent. in the ordinary diorite, and only 1·9 in the resulting biotite gneiss. Water may be got rid of by heat. When the rock is but slightly crushed decomposition of hornblende results, but when there is intense crushing and shearing, accompanied by a high temperature, reconstruction sets in, and biotite is generated.

504. Horne, J.—On the Contact-Metamorphism of the Radiolarian Chert in the Lower Silurian Rocks along the Margin of the Loch Doon Granite.

Rep. Brit. Assoc. for 1892, p. 712.

When the chert approaches within half a mile of the granite, it becomes completely granulitized, yet the radiolaria are still traceable in the matrix. There is here also a slight development of mica. At the edge of the granite the chert has been recrystallized, and consists of large quartz grains with irregular edges and remarkable for the number of its inclusions, and biotite is largely developed as rounded inclusions.

505. Moss, R. J. — On a Graphitic Schist from co. Donegal.

Sci. Proc. Roy. Dublin Soc., vol. viii. pp. 206, 207.

The specimen described is from Glendown Gartan, Letterkenny. It is found in a mining shaft sunk in the metamorphic rocks. The spec. grav. is 2·662, and it yields on analysis—

Water expelled at 100° C.	0·98
,, ,, ,, a red heat	3·68
Carbon	3·15
Sulphur	4·03
Ash	87·89
	99·73

The ash contains—

Silica	58·91
Alumina	19·87
Ferric oxide	7·40
Lime	4·86
Magnesia	1·63
Soda	3·54
Potash	3·73
	99·94

The rock has the lustre of graphite, and soils the fingers.

SEDIMENTARY ROCKS.

*506. Wethered, E.—On the Microscopic Structure of the Wenlock Limestone, with remarks on the formation generally.

Quart. Journ. Geol. Soc., vol. xlix. pp. 236–246, plate vi.

The Wenlock Limestone of three localities has been examined. The first locality is May Hill, where it is divisible into three parts. The lowest, 12 ft., is a massive limestone, in which are remains of crinoids, ostracods, shells, and echinoderm spines. These are often surrounded by a brown crust, in which tubules, called *Girvanella* throughout by the author, are seen. There are also some dark, granulated masses, which, as tubules may be sometimes seen in them, the author regards as probably aggregations of the same organism. The middle, 14 ft., is composed of thin-bedded limestones with remains of polyzoans, ostracods, and crinoids, and in these the aggregations of tubules are the most abundant. The upper 18 ft. are nodular beds containing the same remains, but not many tubules. New forms of *Girvanella* are described from these beds, but no special names are assigned to them. In some cases the nucleus is partially surrounded by smaller tubules, and then the whole has an outer layer of larger tubules. In other cases the tubules are almost certainly seen to branch, which makes the author incline to the belief in their vegetable nature.

The second locality is Purley, near West Malvern, where the section is similar to the last. The lower, massive limestones are here pisolitic, and some of the pisolite grains are surrounded by tubules, and when they cannot be seen the author believes that they are nevertheless present, but have been filled with calcite. There are also organic fragments and isolated aggregations of tubules. The same is the case with the thin-bedded limestones, but the nodular ones show no tubules.

The third locality is Ledbury, where two quarries are described, in which the subdivisions are not easy to correlate with the above, and the aggregations of tubules are not abundant.

There is a considerable quantity of débris in these beds, indicated by the amount of insoluble residue, and there may have been even more before it was decomposed and carried away by water. It increased in quantity in the higher beds. Most of the varieties of *Girvanella* are very local, *G. problematica* being the only one occurring in all the three localities.

*507. Chapman, F.—On Oolitic and other Limestones with Sheared Structure from Ilfracombe.

Geol. Mag., Dec. 3, vol. x. pp. 100–104, plate v.

The author has studied sections of [illegible] limestone [illegible] where the [illegible] are [illegible] and [illegible] with [illegible]. [illegible] shows these limestones [illegible], and in another the [illegible] have become five times as [illegible] as they are broad. [illegible] In another example the [illegible] grains are cut through by strings of [illegible] crystals.

There is, however, [illegible] in the rock, so the author cannot [illegible] as the above would indicate. The most extreme case of shearing is seen at [illegible] Point, where the [illegible] are ten times as long as broad. The "eyes" in this rock are due to [illegible]. In another section specimens of [illegible] are similarly drawn out. It is probable that patches of sheared rock alternate with unsheared patches, and this would afford evidence of crumpling.

***508. Rutley, F.—On the Dwindling and Disappearance of Limestones.**

Quart. Journ. Geol. Soc., vol. xlix, pp. [illegible], plate xvii.

The author first draws attention to the obvious loss from limestones of the material dissolved by percolating water containing carbonic or humus acids, and considers that they may entirely disappear in this way, when the apparent disturbances, "reefs," etc., which might be produced by irregularities of loss, will ultimately be continued. Chert being usually accompanied by limestone, when a bed of it is found alone, the former presence of its companion limestone may be indicated.

If there be three limestones in a series, and the middle one is thinner and disappears, there would result an apparent palæontological break between the faunas of the other two. It is a remarkable circumstance that there are so few limestones amongst pre-Cambrian formations, but this cannot be accounted for by the absence of the material at that date. When a crystalline rock is disintegrated, the process of solution necessarily precedes that of mechanical degradation, and calcium bicarbonate must thus have been produced. The thick limestones occasionally left show that there must have been as much limestone-producing agency of organic nature in early times as now.

When limestones dwindle, the result is the production of nodules, which the author distinguishes from those due to concretion by calling them "residual." He has made experiments on the solution of cubes, etc., of chalk, showing how they assume a rounded form.

***509. Tute, J. S.—On some singular Nodules in the Magnesian Limestone.**

Proc. Yorkshire Geol. and Polyt. Soc., vol. xii. pp. 245, 246.

These nodules are found near Wormald Green, in the lowest beds of the Middle Permian Limestone. They are oval in form, and nearly white, with dark central markings. The author compares them with several nodules near South Shields and Sunderland, the description and analysis of which by R. C. Clapham, in the Trans. Tyneside Nat. F. C., 1861, are quoted.

510. Teall, J. J. H.—Notes on Sections of Stonehenge Rocks belonging to Mr. W. Cunnington.

Wiltshire Arch. and Nat. Hist. Mag., vol. xxvii. pp. 66–68.

Thirty-four specimens of rocks, mostly obtained from under the turf at Stonehenge, have been examined. The diabases (10) are typically ophitic, and are such as occur amongst many West of England palæozoic rocks. The felsites (6) may also be compared with some from the West of England, but must not be confounded with the elvans of Cornwall. The calcareous chloritic schists (7) are in no sense true crystalline schists, but are such as occur in Devon and Cornwall. The grits and sandstones are in no way remarkable.

***511. Cole, G. A. J.—On some examples of Cone-in-Cone Structure.**

Min. Mag., vol. x. pp. 136–141.

The author compares cone-in-cone structure to the radiating groups of crystals of spherulites. Under the microscope the successive cones are seen to be separated by an interval of fine muddy material, so that a horizontal section resembles perlitic structure. We may conceive that the crystallization of one constituent of the rock commences at a number of points on the surface of a bed, or in the interior of a concretion, the growth radiating outwards, and tending to form a cone above each point, while the non-crystallizing material is extruded into the interstices. Sheath after sheath develops round the primary cone, till it is cut short by reaching the surface of the bed or concretion. The author has particularly studied a specimen from the Coal-measures near Wolverhampton, in which cleavage surfaces are seen, and the crystallizing material can be determined to be calcite, the extinction of which takes place when the axes of the cones are parallel or perpendicular to the short diagonals of the nicols; and this observation leads him to the adoption of the crystalline theory in general, cones lying in a group, one within the other, being regarded as belonging to one crystal.

512. Wynne, R. H.—Coal: its varieties and application to Manufactures and the Arts.

Proc. North Staffordshire Inst. of Min. and Mech. Eng., vol. xii. pp. 144–148.

Republished from the Proc. Fed. Inst. of Mining Eng. [*see* No. 401, 1892].

513. Wynne, R. H.—Coal: its varieties and applications to Manufactures and the Arts. Supplementary Notes.

Trans. Fed. Inst. Mining Eng., vol. iv. pp. 510–514 [*see* No. 401, 1892].

It appears that the cause of the difference between caking and non-caking coal is not very clearly made out; but the author inclines to the opinion that the difference depends on the original constitution of the coal itself, and not on its present chemical analysis.

514. Gooch, A. E.—Anthracite and its probable origin.

Collected Tracts, Kenny, printer, Ent. at Stationers Hall, pp. 17–26.

The author quotes the published facts leading to the belief that anthracite *can* be obtained through the agency of heat and water. Whether contortions are necessary is doubtful, as he quotes seven cases in which contorted areas are not anthracitic, and three in which anthracitic areas are not contorted. Whether the fact of the overlying strata being arenaceous assists the formation, is tested by a comparison of published sections. In South Wales the ratio of arenaceous to argillaceous covers is 23 to 13, in the British Coal-field 3 to 2, and in New South Wales 2 to 1. This may be accounted for by the arenaceous strata letting the gases escape more easily and also aiding the access of water. The analysis of a 7·50 per cent. ash from a Welsh anthracite is given, in which 80·56 of ferric oxide is observed, which the author regards as so extraordinary that he hesitates to rely on it.

ECONOMICS.

MINERALS.

515. Mineral Statistics of the United Kingdom of Great Britain and Ireland with the Isle of Man for the year 1892. London, Eyre and Spottiswoode, fol., pp. 125; price 1s. 5d.

The numbers are given in tons.

Alum Clay (*Bauxite*).—Ulster, co. Antrim, 7,322.

Aluminium. — Produced at Walsend and Oldbury. No information.

Alum Shale.—Yorkshire, 2,922.

Antimony Ore.—Cornwall, 6.

Arsenic.—Cornwall, 2,567; Devonshire, 2,547.

Arsenical Pyrites.—Cornwall, 1,086; Devonshire, 3,411.

Barytes. — Cumberland, 156; Derbyshire and Devonshire, 2,705; Durham, 365; Montgomeryshire, 1,051; Northumberland (*carbonate*), 7,000; Shropshire, 6,168; Westmoreland, 548; Yorkshire, 1,204.

Connaught and Munster, 5,050.

Bog Ore. — Dublin and Wicklow, 4,146; Londonderry, 10,097; Mayo, 1,120.

Fireclay and China Clay.—Carmarthenshire, 9,405; Cheshire, 9,417; Cornwall, 408,492; Cumberland, 30,469; Denbighshire, 50,297; Derbyshire, 59,717; Devonshire, 95,856; Dorsetshire, 36,931; Durham, 302,729; Flintshire, 127,314; Glamorganshire, 137,784; Gloucestershire, 5,570; Lancashire, 130,925; ditto and Warwickshire, 71,509; Leicestershire, 38,552; Monmouthshire, 74,560; Northumberland, 145,980; Nottinghamshire, 779; Shropshire, 10,216; Somersetshire and Surrey, 8,802; Staffordshire, 245,357; Warwickshire, 40,781; Worcestershire, 109,750; Yorkshire, 243,101.

Ayrshire, 89,093; Clackmannan, 2,810; Dumbartonshire, 31,152; Dumfriesshire and West Stirlingshire, 209; Edinburghshire, 33,642; Fifeshire, 37,618; Haddingtonshire, 7,526; Lanarkshire, 256,653; Linlithgowshire, 18,062; Renfrewshire, 39,622; East Stirlingshire, 52,352.

Tyrone, 3,942.

Other Clays.—Devonshire (Black), 200; Shropshire (Red), 41,691; Bedfordshire (Fuller's Earth), 3,703; Buckinghamshire and Derbyshire (Fireclay), 200; Devonshire (Potter's Clay), 32,688; Dorsetshire (Potter's Clay), 37,368; Somersetshire (Fuller's Earth), 4,965; Surrey (Fuller's Earth), 755.

Coal.—Breconshire, 213,597; Carmarthenshire, 696,903; Cheshire, 666,773; Cumberland, 1,424,749; Denbighshire, 2,095,644; Derbyshire, 11,141,152; Durham, 23,834,027; Flintshire, 864,517; Glamorganshire, 22,808,314; Gloucestershire,

1,226,933; Lancashire, 22,356,171; Leicestershire, 1,500,235; Monmouthshire, 7,407,604; Northumberland, 9,528,834; Nottinghamshire, 7,159,750; Pembrokeshire, 80,942; Shropshire, 642,588; Somersetshire, 855,690; Staffordshire, 14,132,827; Warwickshire, 1,786,830; Westmoreland, 1,364; Worcestershire, 867,708; Yorkshire, East and West Riding, 23,185,508; Yorkshire, North Riding, 4,407. Total 154,483,067.

Argyle and Dumfries, 95,779; Ayrshire, 3,579,216; Clackmannan, 412,489; Dumbarton, 434,786; Edinburgh, 928,721; Fife, 3,573,818; Haddington, 296,995; Kinross, Peebles, and Sutherland, 19,128; Lanark, 15,252,977; Linlithgow, 778,576; Renfrew, 74,212; Stirling, 1,745,226. Total, 27,191,923.

Connaught, 10,038; Leinster, 83,777; Munster, 13,426; Ulster, 4,640. Total 111,881. Grand total, 181,786,871.

Copper Ore.—Cardiganshire, 19; Carnarvonshire, 196; Cornwall, 2,873; Devonshire, 2,818; Lancashire, 74; Merionethshire, 50; Yorkshire, North Riding, 18; Isle of Man, 4.

Scotland, 3.

Copper Precipitate.—Anglesey, 265; Devonshire, 5.

Fluor Spar.—Cornwall, 73; Derbyshire, 98.

Gold Ore.—Merionethshire, 9,990 (2,835 oz. gold). Value of gold, £10,511.

Gypsum.—Cumberland, 31,310; Derbyshire and Nottinghamshire, 83,268; Staffordshire, 22,254; Sussex, 5,310; Westmoreland, 5,398.

Iron Ore.—Breconshire, 213; Carmarthenshire, 54; Cornwall, 691; Cumberland, 1,355,938; Derbyshire, 13,415; Devonshire, 2,556; Durham, 9,275; Glamorganshire, 27,076; Gloucestershire, 63,149; Lancashire, 85,395; Leicestershire, 68,985; Lincolnshire, 1,459,404; Monmouthshire, 24,756; Northamptonshire, 1,120,365; Oxfordshire and Rutlandshire, 86,229; Shropshire, 58,044; Somersetshire, 881; Staffordshire, 1,040,640; Warwickshire, 948; Wiltshire, 70,866; Yorkshire, 3,493,216; Isle of Man, 13.

Ayrshire, 337,210; Dumbartonshire, 104,340; Edinburghshire, 72,295; Fifeshire, 14,635; Lanarkshire, 115,287; Linlithgowshire, 45,660; Renfrewshire, 181,292; Stirlingshire, 1,716.

Antrim, 76,739.

Iron Pyrites.—Cardiganshire, 4; Carnarvonshire, 3,700; Derbyshire, 1,239; Lancashire, 714; Nottinghamshire, 252; Shropshire, 332; South Staffordshire, 1,290; Warwickshire, 2,918; Yorkshire, 30.

Dumbartonshire, 10.

Wicklow, 3,478.

Jet.—Yorkshire, 929 lbs. (761 lbs. from Hinderwell).

Lead Ore. [S = with silver].—Anglesey — (S 4,219 oz.); Breconshire, 169; Cardiganshire, 1,345 (S 12,662 oz.); Carmarthenshire, 777; Carnarvonshire, 115 (S 334 oz.); Cornwall,

15; Cumberland, 2,208 (S 18,387 oz.); Denbighshire, 1,429 (S 4,284 oz.); Derbyshire, 3,810; Durham, 6,314 (S 40,259 oz.); Flintshire, 5,327 (S 35,125 oz.); Montgomeryshire, 218 (S 1,490 oz.); Northumberland, 2,508 (S 2,800 oz.); Shropshire, 2,112; Somersetshire, 108; Westmoreland, 1,482 (S 13,662 oz.); Isle of Man, 6,698 (S 124,949 oz.).

Lanarkshire, 2,019 (S 1,736 oz.); Dumfriesshire, 2,025 (S 11,137 oz.).

Wicklow, 43 (S 413 oz.); Monaghan, 20.

Lignite.—Devonshire, 4,247.

Manganese Ore. — Derbyshire, 119; Devonshire, 840; Merionethshire, 5,119.

Ochre and Umber. — Anglesey and Isle of Man, 3,407; Cornwall, 196; Cumberland, 149; Derbyshire, 414; Devonshire, 3,184; Gloucestershire, 666; Lancashire, 100; Somersetshire, 3,346.

Wicklow, 669.

Oil Shale.—Cumberland, 1,981; Dorsetshire, 70; Flintshire, 1,872; North Staffordshire, 4,663; Yorkshire, 4,275.

Edinburghshire, 803,888; Fifeshire, 109,839; Lanarkshire and Renfrewshire, 126,619; Linlithgowshire, 1,032,312; Stirlingshire, 4,418.

Petroleum.—North Staffordshire, 218.

Phosphate of Lime. — Bedfordshire, Cambridgeshire, and Suffolk, 12,200.

Rock Salt.—Cheshire, 138,753; Lancashire, 1,700.

Antrim, 34,805.

Salt from Brine. — Cheshire, 1,313,328; Durham, 180,645; Lancashire, 39,889; Staffordshire, 4,650; Worcestershire, 192,339; Yorkshire, 50,415.

Silver from Lead Ore, 271,259 oz.

Slates and Slabs.—Cardiganshire, 319; Carnarvonshire and Denbighshire, 256,240; Cornwall and Devonshire, 1,170; Lancashire, 7,651; Merionethshire, 144,112; Montgomeryshire, 2,252; Westmoreland, 1,212.

Scotland, no returns.

Stone, etc.—Total value estimated for England and Wales, £7,341,571; for Scotland, £1,039,541; for Ireland, £286,624. Only a small proportion of this is obtained from mines, to wit—

Bedfordshire (Silver sand) —; Breconshire, (Gannister) 15,283; Buckinghamshire, (Chalk) —; Carmarthenshire, (Shale) 2624; Cardiganshire, (Paving stone) 90; Cheshire, (Gannister) 623; Cumberland, (Gannister) 7,992; Denbighshire, 280; Derbyshire, (Chert) 3,256, (Calc spar) 2661, (Limestone) 698, (Gannister and Sand) 820; Devonshire (Freestone) and Dorsetshire (Purbeck stone), 11,066; Durham, (Whinstone, Flags, etc.) 1,006; Flintshire, (Ferruginous limestone) 250; Glamorganshire, (Building stone) 1,894, (Yellow clay) 280; Gloucestershire, (Freestone) 698; Lancashire, (Building stone)

2,100, (Hydraulic limestone and Flags) 62,688; Leicestershire, Northamptonshire, and Warwickshire, 89,032; Merionethshire, 803; Monmouthshire, (Building stone) 1,834, (Gannister) 2,028; Northumberland, (Limestone) 836; Shropshire, (Limestone) 1,996, (Calc spar) 721; Somersetshire, (Freestone) 3,098; Staffordshire, (Silurian limestone) 45,447; Suffolk, (Gun flints) 3,173,000; Surrey, 5,061, (Silver sand) 2,474, (Hearthstone) 4,357; Wiltshire, (Freestone) 104,484; Worcestershire, (Silurian limestone) 58,653; Yorkshire, (various) 206,781.

Ayrshire, (Gannister and Shale) 926, (Limestone) 1,030, (Hone stone) 341; Dumbartonshire, (Limestone) 6,294, (Gannister) 275; Dumfriesshire, (Limestone) 1,140; Edinburghshire, (Limestone) 174,992; Fifeshire, (Limestone) 55,046; Lanarkshire, (Shale) 6,593, (Limestone) 41,153; Linlithgowshire, (Limestone) 6,397; Renfrewshire, (Limestone and Shale) 5,020, (Building stone) 10,731; Stirlingshire, (Gannister) 8,058, (Limestone) 16,535.

Strontia Sulphate.—Gloucestershire and Somersetshire, 5,066.

Tin Ore.—Cornwall, 14,559; Devonshire, 96.

Uranium Ore.—Cornwall, 37.

Wolfram.—Cornwall, 125.

Zinc Ore.—Anglesey, 470; Cardiganshire, 2,442; Carnarvonshire, 138; Cornwall, 12; Cumberland, 6,815; Denbighshire, 6,438; Derbyshire, 474; Flintshire 2,995; Montgomeryshire, 179; Shropshire, 409; Isle of Man, 3,380.

Dumfriesshire, 128.

In this year's statistics are included the mineral produce of the Colonies for the year 1891, compiled from various published sources. Extracts are here given for all those which have yielded more than 1,000 tons or ounces, etc., as the case may be :—

Cape of Good Hope.—Asbestos, 83,015 lbs.; Coal, 27,677 tons; Copper ore, 23,691 tons; Crocidolite, 15,962 lbs.; Diamonds, 3,255,543 carats; Gold, 790,422 ozs.; Salt, 1,778,984 lbs.

Cyprus.—Flagstones, 7,506; Gypsum, 2,901 tons; Amber, 2,314 lbs.

Gold Coast.—Gold, 24,475 ozs.

Natal.—Coal, 126,444 tons; Stone, 77,150 tons.

India.—Coal, 2,328,577 tons; Iron ore, 33,335 tons; Salt, 1,015,912 tons; Petroleum, 6,136,495 gallons.

Ceylon.—Cement, 2,161 bushels; Plumbago, 20,027 tons; Salt, 1,999 tons; "Cabook" stone, 3,560,000 blocks; Granite, 6,967 cubes.

New South Wales.—Coal, 4,037,929 tons; Coke, 30,310 tons; Copper, 4,526 tons; Gold, 153,336 ozs.; Limestone, 74,057 tons; Oil shale, 40,349 tons; Silver, 729,590 oz.; Silver-Lead ore, 147,780 tons; Tin ore, 3,415.

New Zealand.—Coal, 668,794 tons; Coke, 2,544 tons; Gold,

251,996 oz.; (Kauri gum, 8,388 tons); Manganese ore, 1,153 tons; Silver, 28,023 oz.

Queensland.—Coal, 271,603 tons; Gold, 576,439 oz.; Stone, 68,571 tons; Tin ore, 2,236 tons.

South Australia.—Copper, 3,552 tons; Copper ore, 13,035 tons; Gold, 6,904 oz.; Salt, 7,507 tons; Slates, 170,000.

Tasmania.—Coal, 45,524 tons; Gold, 39,203 oz.; Silver-Lead ore, 4,810 tons; Stone, 93,838 cub. ft.; Limestone, 5,051 tons; Tin ore, 4,322.

Victoria.—Coal, 22,834 tons; Gold, 576,399 oz.; Lignite, 6,322 tons; Silver, 30,039 oz.; Slates, 2,274 tons; Tin ore, 1,778 tons.

Western Australia.—Gold, 30,311 oz.

Guernsey and Jersey.—Stone, 228,484 tons.

Canada.—Asbestos, 8,035 tons; Coal and Coke, 3,087,110 tons; Copper, 4,254 tons; Flagstone, 27,300 sq. ft.; Gold, 51,040 oz.; Granite, 9,817 tons; Gypsum, 181,737 tons; Pig Iron, 21,331 tons; Iron ore, 61,588 tons; Limestone flux, 10,157 tons; Nickel ore, 2,065 tons; Petroleum, 755,298 barrels; Phosphate of lime, 21,061 tons; Pyrites, 58,359 tons; Salt, 40,197 tons; Silver, 415,493 oz.

Newfoundland. — Copper ore, 10,686 tons; Iron pyrites, 19,150 tons.

British Guiana.—Gold, 101,298 oz.; Granite, 5,283 tons.

West Indies.—Phosphates, 1,960 tons; Asphalt, 95,989 tons.

***516. Kendall, J. D.—The Iron Ores of Great Britain and Ireland, their Mode of Occurrence and Origin, and the Methods of searching for and working them, with a Notice of some of the Iron Ores of Spain.**

London, Crosby, Lockwood, 8vo, pp. 430, with five plates.

This book is obviously written by one thoroughly familiar with his subject. Part I. commences with the early history of iron ore working, followed by a complete account, up to 1890, of all the separate iron-bearing areas.

Part II. is "the geological position, form, and inner nature of iron ore deposits," of which the following table is given:—

Lower Basalt	Antrim	Limonite.
Lower Greensand	Seend	,,
Middle Neocomian	Tealby	,,
Coral Rag	Westbury	Limonite and Siderite.
Northampton Sand	Cleveland, Northants, Lincolnshire, Rutland	,, ,, ,,
Lower Oolite	Rosedale	Magnetite.
Marlstone	Cleveland, Lincolnshire, Leicester, Oxford	Limonite and Siderite.
Lower Lias	Frodingham	,, ,, ,,

Coal-measures	Scotland, York, Derby, Stafford, Salop, Warwick, S. Wales.	Siderite.
Yoredale	Weardale and Alston Moor	Siderite and Limonite.
Carboniferous Limestone	Northumberland	Siderite.
	Glamorgan, Forest of Dean	Limonite.
	West Cumberland, Furness	Hæmatite.
Middle and Lower Devonian	Devonshire and Cornwall	All kinds.
Coniston Limestone	Water Blean, Cumberland	Hæmatite.
Skiddaw Slates	Knockmorton and Kelton Fell, Cumberland.	"

The hæmatites of Cumberland and Furness are then described. The author considers that the Carboniferous series of the Whitehaven district shows five bands of limestone belonging to the Yoredales, and two belonging to the Mountain Limestone, and in each ore deposits occur. A section of the shales and limestones at Furness shows 715 ft. in 114 subdivisions, with conglomerate at the base. At Windhills, near Stainton, a boring showed: Surface deposits, 31 ft.; Yoredales, 744 ft. in 30 subdivisions; and Carboniferous Limestone, 946 ft. in 25 subdivisions. In some borings the bore-holes seem to enter caves filled with débris, as at Crossgates, where there was 127 ft. of such material. In a boring near Gleaston, the Yoredales were found to be 1410 ft. thick. The Carboniferous rocks in this district are divisible into two parts, the upper of which—the Whitehaven sandstone—is transgressive beyond the limits of the lower and yields hæmatite at Millyeat, where it is 159 ft. thick. The Drift deposits at Furness amount to 537 ft.

The deposit of ore in the Eskdale granite is of no commercial importance, though it has been worked near Boot, in Nab Ghyll, where one sample of ore yielded 19·20 per cent., and another 64·84 of metallic iron. In the Skiddaw Slate, ore is worked at Kelton Fell, where the veins all hade east at 45°–80° with the horizon. In these veins the ore material lies parallel to the cheeks; the kidney ore, with few exceptions, having the convexity turned towards the centre of the vein. Different analyses give 62·45, 56·15, and 48·40 per cent. of iron. In the Coniston Limestone the ore is worked for paint, as it is; and also for the metal, at Water Blean, near Mellom. It here lies in cavities on the surface of the limestone, covered in by Boulder-clay; the supposed trees found therein are only concentrically formed pipes of kidney ore.

In the Carboniferous Limestone hæmatite deposits occur under four forms, viz. bed-like, vein-like, dish-like, and irregular. The first form is peculiar to the Whitehaven district, being unknown in that of Furness; the reason probably being that in the former there are more alternations of strata. Here the limestone often changes along the bedding into a siliceous substance known as "whirlstone," which forms the floor of the

ore-bed. The ore runs north and south, and extends upwards in the form of "guts" into the limestone. The vein-like deposits often lie along N. and S. faults, which, in the Whitehaven district, usually hade at about 50° to the east, while in the Furness district they usually hade to the west. There are, however, a few hæmatite bearing E. and W. faults. The only dish-like deposit of importance in West Cumberland is that at Hodbarrow, which has an area of 1000 yds. by 400 yds., and an average depth of 65 ft.; in Furness, however, they are common. The irregular deposits occur in the heart of the limestone, and enclose [according to the figures] irregular nuclei of sand in the centre. Five analyses of Whitehaven ores are given, showing:—

	Maximum.	Minimum.
Peroxide of iron	98·26	62·63
Protoxide of manganese	·34	tr.
Silica	21·74	1·52
Alumina, etc.	3·88	1·88
Phosphate of iron	·30	—
Phosphoric acid	·05	·02
Sulphur	·04	—

The ores contain microscopic cavities, which in the siliceous varieties are filled with quartz.

The Furness ores are of three kinds—1. Hard blue purple ore, like that of Whitehaven; three analyses of this are given, showing ferric oxide varying from 78·61 to 94·23 per cent. In these there are often larger spaces called "loughs," which are filled with spar and kidney ore as a lining. 2. Dull reddish-purple ore, the ferric oxide ranging from 77·24 to 86·50 per cent. 3. Soft dark ore. This is the commonest, and four analyses are given showing ferric oxide from 60·61 to 84·47, and manganese oxide, ·22 to 2·22 per cent.

A short chapter follows on the ores of Cornwall.

In the Forest of Dean the ironstone usually occurs as chambers or "churns" in a crystalline limestone called "crys." Three varieties are known as brush, smith, and grey. Notices follow of the ores of S. Wales and Weardale, and under the general head of Carboniferous rocks a number of sections, analyses, and lists of fossils are quoted. It is noted that since the year 1855 the amount of Carboniferous ore raised (of which an increasing proportion is from the limestone) has decreased by 46 %, while the amount raised from Secondary rocks has increased nearly 900 %. Some account is then given, mostly by quotation from two previous papers by the author, of the ironstones of Frodingham, Cleveland, Caythorpe, Holwell, Fawler, North Yorkshire Top Seam, Rosedale, Mid-Lincolnshire, Cottesmore, Northamptonshire, Westbury, Claxby, and Seend, and also a comparative table of sections showing the position of the several seams in the geological series, and

a good longitudinal section comparing the ironstone of Eston with that of Grosmont in Yorkshire. It is noted as a rule that these deposits of ironstone have a substratum of clay, and that the ironstone never attains its maximum on two horizons in the same district. The descriptive part concludes by quoting accounts, partly from the author's previous writings of the iron ores of Antrim and Spain.

Part III. deals with the age and origin of the deposits. The hæmatites of West Cumberland are younger than the bulk of the Coal-measures, for some of them are interstratified in Upper Coals. They are older than the Permian breccia, which contains water-worn pebbles of hæmatite. The hæmatites of S. Wales and the Forest of Dean are probably of Permian age, and so, less certainly, are those of Cornwall and Alston. No hæmatite occurs in beds younger than the Trias. It is certain in some cases that the mineral was not deposited in any pre-existing cavern, because a string of shale in the limestone continues right across the deposit into the limestone on the other side. Moreover the roofs are often of shale, which falls as soon as the ore is removed. The author's view of the origin of hæmatite, first enunciated in 1874, is that it is due to replacement of the limestone particle by particle through chemical action on perchloride of iron in solution. In like manner the author quotes himself as considering the iron ores of the Secondary rocks due to the replacement of ordinary limestone by iron salts derived from the adjacent clays.

Part IV. deals with the searching for and working ore, and other technical matters.

517. Morris, T.—Geological, Manufacturing, and other Notes on Iron.

Trans. Liverpool Engineering Soc., vol. xiv. pp. 84–98.

The geology is of a speculative character, dealing with the supposed derivation of iron ore from granite.

***518. Woodward, H. B.—On a Bed of Oolitic Iron Ore in the Lias of Raasay.**

Geol. Mag., Dec. 3, pp. 493–495. (Read at Brit. Assoc.)

This bed cannot be reached in the vertical sea-cliffs, but is traced in burns and braes inland, between Raasay Manse and Beinn-na-Leac. It occurs at the top of the Middle Lias, and is overlain by shales with *Ammonites annulatus*, and underlain by calcareous sandstones with *Am. spinatus*, *Rhynchonella tetrahedra*, etc. It is a greenish-grey oolitic rock, weathering brown at the surface. It thus corresponds in position and character with the Cleveland ore. It has a thickness of 5 ft. and yields 29% of metallic iron in the blue, and 37% in the brown ore.

***519. Collins, J. H.—On the Origin and Development of Ore Deposits in the West of England. Chapter III.: Rock Change as concerned in the Formation of Ore Deposits.**

Journ. Roy. Inst. Cornwall, No. xxxix. pp. 117–167.

For Chapters I., II., *see* No. **605**, 1890, and for the first part of Chapter III., No. **404**, 1892. The author points out that in capillary fissures and in the interstices between minerals, deposits may take place owing to the new conditions introduced in the percolating fluid by surface tension.

He next recapitulates, in 17 paragraphs, the results arrived at in 1836, by Mr. Fox, relative to the electricity displayed by mineral veins, the gist of which is that mineral matter taken into solution at great depths, and exposed to differences of temperature, or by coming into contact with other solutions, would cause electrical currents, which, in their turn, cause a deposit of metallic ore of one kind or another, according to the electropositive or negative character of the rock in relation to its surroundings. Such veins will run E. and W., while the N. and S. courses will be filled mechanically. The author agrees that local currents may be set up by the different electrical states of adjacent rocks, and notes the common occurrence of minerals near contact zones, but considers that the general Amperian currents cannot be shown to have any connection with the matter.

The oxides met with in Gonsans, except those of tin and manganese, result mainly from the alteration of pre-existing sulphides which are often met with in depth. They are produced by freely circulating waters, and hence usually cease at the water-level, the exceptions being explained by, now exhausted, thermal springs. Kaolinization is produced by similar action on felspars, but kaolin on a large scale seems to require the presence of fluorine. Serpentinization, uralitization, amphibolization, and schillerization are alluded to as similar results on other minerals. Alunation results from the decomposition of pyrites in the neighbourhood of aluminous silicates. The percolation of carbonated waters through calcareous sands, on the coast of Cornwall, has converted them into building sandstones. An average of grains of silica per gallons is found in the Cornish mine waters, and the cross courses often have a different form of quartz from that in the E. and W. lodes, which is known as cross-course spar. Great cairns of quartz are found at intervals from Dodman to Mawgan, in Meneage; and on the north coast, between Padstow and St. Ives, the sandstones are locally indurated into scythe stones. The production of chalcedony and opal is thought to be due to thermal springs, the latter when the temperature is highest.

Theories of the origin of ore deposits are next discussed, and that of infiltration alone admitted, either by downward,

lateral, or, in the case of the insoluble sulphides, upward passage of water. Alkaline waters under ordinary conditions of pressure and temperature are capable of dissolving tin oxide, as it is found impregnating deer's horns. The materials in such cases cannot in all cases be supplied in sufficient abundance from the country rock at workable depths, but must have a deep-seated origin; the phenomena of "congenial" and "uncongenial" country rock are often due to their varying precipitating power. The capels are silicified borders, often schorlaceous, and sometimes impregnated with tin. Details are finally given as to the unequal distribution of the several mineral substances in the Cornish mining district.

520. Halse, E.—Notes on the occurrence of Manganese Ore near the Arenigs in Merionethshire.

Trans. N. England Inst. Min. and Mech. Eng., vol. xlii. pp. 45, 46; and Trans. Fed. Inst. Min. Eng., vol. iv. pp. 167, 168.

An addendum to No. 408, 1892, giving a complete analysis (Johnson, Matthey & Co.) of the principal vein, viz.:—

Peroxide of manganese	55·3
Protoxide of manganese	12·3
Oxide of iron	7·2
Oxide of cobalt	1·4
Alumina	6·8
Silica	10·0
Combined water	5·8
Other ingredients	1·2
	100·00

The metallic manganese varies from 38 to 54 per cent., the phosphorus from ·043 to 1·608, and the insolubles from 2 to 10 per cent.

521. Reyer, E.—History of Tin.

Trans. Min. Inst. Cornwall, vol. iv. pp. 138–150.

The name "tin" is of Gallic origin, being derived from "ostean," Cornish "stean." It is estimated that in 1881 the production of tin in the various parts of the world was: Australia, 10,000 to 15,000 tons; England, 10,000; Straits of Malacca, etc., 10,000; Banca and Billeton, 7,000 to 9,000; Tasmania, 3,000 to 5,000; and China, 5,000 tons.

***522. Aitken, H. — The Hilderston Silver Mine near Linlithgow.**

Trans. Fed. Inst. Min. Eng., vol. vi. pp. 193–198.

The vein lies on a whinstone dyke. It has been worked near the surface, and dies out below.

COAL AND OIL SHALE.

523. Stirrup, M.—On some Recent Estimates of the World's Coal Supply.

Trans. Manchester Geol. Soc., vol. xxii. pp. 227–234.

The author disputes the estimate made by Herr Nasse, and quoted in the *Standard*, particularly with reference to America, details of whose coal-fields are cited.

524. Shipman, J.—The Coal-Measures of the Leen Valley.

Colliery Guardian, vol. lxvi. p. 1071.

A general lecture delivered at Mansfield.

525. Anon.—The Flintshire Coal-field.

Colliery Guardian, vol. lxv. pp. 253, 254, and 311.

Deals with the workings at various collieries.

526. M. E.—The Lancashire Coal-field.

Colliery Guardian, vol. lxv. pp. 31, 32, 77, 78, and 114.

527. M. E.—The North Staffordshire Coal-field.

Colliery Guardian, vol. lxv. pp. 906 and 972.

528. M. E.—The South Staffordshire Coal-field.

Colliery Guardian, vol. lxv. pp. 532, 580, 621, 622, 667, 716, 717, 767, 809, and 810.

529. M. E.—The Clydesdale Coal-field.

Colliery Guardian, vol. lxv. pp. 1070, 1097, 1144, and 1190; and vol. lxvi. pp. 16, 17, 60, 104, 147, 189, 235, 256, and 270.

530. M. E.—The Ayrshire Coal-field.

Colliery Guardian, vol. lxvi. p. 324.

531. Anon.—The Clackmannan Coal-field.

Colliery Guardian, vol. lxvi. pp. 367, 368.

532. M. E.—The Fifeshire Coal-field.

Colliery Guardian, vol. lxvi. pp. 409, 410, 456, 457, and 499, 500.

533. M. E.—The Lothian or Edinburgh Coal-field.

Colliery Guardian, vol. lxvi. pp. 593, 594, 636, 775, 776, and 773, 774.

534. M. E.—The Northumberland Coal-field.

Colliery Guardian, vol. lxvi. pp. 822, 869, 917, 918, 974, 1010–1012, and 1558, 1559.

535. M. E.—The Durham Coal-field.

Colliery Guardian, vol. lxvi. pp. 1106 and 1153, 1154.

All these are similar papers to No. **525**.

***536. Bertrand, M.—The Correlation of the Coal-fields of Northern France and Southern England.**

Trans. Fed. Inst. Mining Eng., vol. v. pp. 106–125, plate v.

This is practically the same paper as No. **137**.

***537. Holmes, T. V., Taylor, J. E., and Whitaker, W.—Geological Report to the Eastern Counties Coal Boring and Development Syndicate, Limited.**

Ipswich, 8vo, pp. 15; privately printed.

The first author thinks that the best place for a first experimental boring would be 3–4 miles N.E. of Colchester. The Lower Carboniferous rocks having been struck at Harwich, the Coal-measures are more likely than rocks of other ages to be associated with them, while the restriction of the damage done by the Essex earthquake in 1884 to the tract between Colchester and Mersia, may have been due to a Palæozoic ridge of rocks, older than the Carboniferous, being nearer to the surface there.

The second author observes that at Harwich and Culford practically no oolites were passed through, and at the latter place the Palæozoic ridge was only 640 ft. below the surface. For the exact site of the coal-fields we must trust to a number of experimental borings.

The third author thinks the coal is as likely to extend from Dover, in a northerly as in a westerly direction. [On this question see "Introductory Review," 1892.]

538. Gifford, W.—Are there Coal-fields in Surrey?

Proc. Holmesdale Nat. Hist. Club for 1890–1–2, pp. 42–47.

The author goes through the history of the search for coal in the South-east of England, and thinks it probable that a boring might be successful underneath the Chalk between Holmesdale and Croydon, and has offered a site for the purpose two miles east of Caterham.

539. Atkinson, J. B.—The Mining-fields of Scotland.

Trans. Min. Inst. Scotland, vol. xiv. pp. 205–220, with a Geological Map of Scotland.

A presidential address, giving a short general account. The map is reduced to the scale of 10 miles to ¼ inch from that published by Sir A. Geikie [No. **452**, 1892].

540. Martin, R.—The Midlothian Coal-Basin.

Trans. Fed. Inst. Min. Eng., vol. vi. pp. 388–392, pls. ix., x.

Some miscellaneous notes are given about the coal-fields, and in an appendix is a list of all the seams in the Musselburgh, Newbattle, and Loanhead districts. In the Musselburgh district there are 11 seams in the Upper Coals, and 18 in the Carboniferous Limestone; at Newbattle 11 seams, and at Loanhead 15 seams in the Carboniferous Limestone series. The plate ix. is an uncoloured reproduction of the new edition of the Geological Survey Map [No. **447**, 1892].

541. Moore, R. T.—The Mineral Oil Industry of Scotland.

Trans. Fed. Inst. Min. Eng., vol. iv. pp. 36–47, plate iii.

In the plate is shown the distribution of the Calciferous Sandstone series, in which the oil-shales occur in the lowland valley of Scotland. The thickness of the shale-bearing strata is about 3000 ft. The following shales are recognized: The Dam, Mungle, Grey, Fell, Broxburn, Dunnet, Barracks, and Pumpherston. Oil-shale has a spec. grav. of 1·75, and, if rich, will curl up when a shaving is cut off by a knife. The upper seams are richer than the lower ones, but the Pumpherston shales are especially rich in ammoniacal salts. Short sections are given at 23 different localities. The remainder of the paper deals with methods of working, refining, etc.

542. Constable, J.—Notes on the Scottish Shale Works.

Journ. Brit. Soc. Min. Students, vol. xv. pp. 95–104.

Gives a list of the various shale seams, viz. :—

	ft.
Hurlet line and coal	
Strata	48
Auldton limestone	
Strata	480
Raeburn shale	
Strata	120
Mungle shale	
Strata	144
Two-feet coal	
Strata	204
Grey shale	
Strata	84
*Houston coal	
Strata	162–216
*Fells shale	
Strata	180–300
*Broxburn shale	
Strata	240–420
Dunnet's shale	
Strata	390
Barracks shale	
Camp limestone	
Strata	720
Pumpherston shale	

Those marked * are illustrated by detailed sections.

***543. Mansel-Pleydell, J. C.—Kimmeridge Shale in its Economic Bearings.**

Reprinted from a local paper.

Gives an account of these shales at Kimmeridge. The bitumen is thought to be derived from the buried Saurians and other animal remains. The shale was first worked towards the end of the 16th century, and has been since worked at intervals; but though it contains as much as 75 per cent. of volatile matter, the oil smells so badly as to be practically unsaleable.

BUILDING STONES.

***544. Cole, G. A. J.—The Beauty and Use of Irish Building Stones.**

The Irish Naturalist, vol. ii. pp. 168–171 and 179–181.

General observations.

WATER SUPPLY.

***545. Etheridge, R.—On the Rivers of the Cotteswold Hills within the Watershed of the Thames, and their importance as Supply to the Main River and the Metropolis.**

Proc. Cotteswold Nat. F. C., vol. xi. pp. 49–101, with three tables and a coloured geological map.

An account is given of the increase or decrease of the amount of water along the courses of the various tributaries, giving the areas of the several formations within their respective basins. Then follow many general remarks on the physical, geological, and hydrological conditions of the area.

From the tables we learn that the following areas in square miles of the various formations are drained by the river Thames and its tributaries:—

Lower Lias	96·75	Lower Calc. Grit	49·25
Middle Lias	77·75	Coral Rag	47·25
Upper Lias	55·75	Upper Calc. Grit	7·
Lower Oolite Sand	13·5	Kimmeridge Clay	128·5
Inferior Oolite	120·75	Portland Beds	29·75
Fuller's Earth	22·	Purbeck	1·5
Great Oolite	256·5	Lower Greensand	13·5
Forest Marble	80·5	Gault	120·75
Cornbrash	66·5	Upper Greensand	25·
Oxford Clay	388·75	Chalk	64·75

The maximum and minimum thicknesses within the area are:—

Lower Lias	600 ft. at Cheltenham—100 ft. at Burford.
Middle Lias	280 ft. at Bredon—18 ft. at Burford.
Upper Lias	290 ft. at Clewe Cloud—6 ft. at Burford.
Upper Lias Sands	200 ft. at Camlong Down—0 at Burford.
Inferior Oolite	264 ft. at Leckhampton—20 ft. at Burford.
Fuller's Earth	140 ft. at Kingston—30 ft. at Cheltenham.
Great Oolite	225 ft. at Compton Abdale—10 ft. at Shipton Downs.
Forest Marble	60 ft. at Tetbury—40 ft. at Coln Rogers.

The total permeable area is 853 square miles, and the total impermeable area is 812 square miles.

546. — Report of the Royal Commission appointed to inquire into the Water Supply of the Metropolis.

London, Eyre and Spottiswoode, fol. C 7172, pp. 72; price 7½*d.*

The Commissioners consider that 35 gallons per head per diem should be allowed for each inhabitant of greater London. Estimating the inhabitants at 11 millions in 1931, and adding 6 per cent. for contingencies, the total requirement is over 415 million gallons daily. The possibility of certain schemes for

With regard to the objection raised that the abstraction of more water from the Chalk of the Lea valley would practically dry up the streams, Mr. Middleton has ascertained that there is no reliable evidence of the permanent depletion of any well, except from local pumping, the wells which have apparently dried up having been sunk in exceptionally wet years, nor is there any evidence of the permanent lowering of the source of any river. Only the Bulbourne, the Gade, and the Ver have varied at all, and these also varied before any pumping operations commenced; nevertheless, the commissioners cannot affirm that the abstraction of five times the present quantity would have no effect. Taking the area of Chalk in the Lea valley as 422 square miles, 95 of which are bare, and reckoning for a percolation of 3·37 inches per annum, it is calculated that 56 million gallons can be thence extracted without injury. They disagree with the "cistern" theory, which states that if the water is taken out of the lower levels of a stratum, the upper level of the water will be lowered, because, in pumping, a conical depression is produced; and they argue that pumping from an underground stream, flowing in a known direction, will have little effect upon the water above. In other words, they consider that the pumps derive their water from the flowing leakage, and this is called the "river" theory. Their contention is confirmed by the ascertained fact that the water gradient in the various wells has not been affected by pumping in the past, although further south, beneath London, excessive pumping has caused the gradient to become steeper.

In conclusion, it is stated that from the Lea valley 40 million gallons per diem can be got from the Chalk; on the south side of the Thames 27½ millions from the Chalk in the Kent Company's district, and an unknown quantity in the area to the east; 52½ millions can be had by storage from the Lea, and 300 millions from the Thames. The second part of the report deals with the quality of the water.

547. — Minutes of Evidence taken before the Royal Commission on Metropolitan Water Supply.

London, Eyre and Spottiswoode, fol., C 7172 (I.), pp. 555; price 4*s*. 6*d*.

There is a considerable amount of geological information of very various kinds in the examinations of **W. B. Dawkins** (mostly dealing with chalk water); **C. E. de Rance** (various); **R. Etheridge** (Upper Thames valley); **Sir J. Evans** (percolation through chalk—cistern theory); **A. H. Green** (Upper Thames valley); **W. Topley** (drifts, water in chalk, Upper Thames valley, springs, etc.); **W. Whitaker** (chalk and surface deposits, nailbournes, springs; **H. Woodward** and **H. B. Woodward** (Upper Thames valley).

548. — Appendices to the Minutes of Evidence taken before the Royal Commission on Metropolitan Water Supply.

London, Eyre and Spottiswoode, fol., C 7172 (II.), pp. 692; price 5*s.* 6*d.*

Amongst these appendices will be found the following of geological interest:—

Bennie, A. R.—On chalk wells in and around the county of London, pp. 142–170. A list of 173 is given, showing depth to chalk, depth in chalk, surface-level above O.D., and past and present water-levels, with remarks.

Easton, E.—The Chalk as a source of supply, p. 368.

Topley, W.—The water-bearing qualities of the rocks within and adjacent to the basins of the Thames and Lea, pp. 411–413.

Topley, W.—Reservoir sites in the Upper Thames valley, p. 413.

Topley, W.—Measurements of the geological areas in the basins of the Thames and Lea, p. 414.

Topley, W.—The Chalk area of East Kent, p. 415.

Woodward, H., and Woodward, H. B. — Geological character of the reservoir sites selected by Messrs. Marten and Rofe, p. 418.

Dawkins, W. B.—Proposed sites for reservoirs in the Upper Thames Basin, p. 425.

Green, A. H.—Proposed sites for reservoirs in the Upper Thames Basin, p. 426.

Whitaker, W.—The Chalk as a source of water supply, p. 429.

Whitaker, W. — Swallow-holes in the Chalk of the Thames Basin, p. 429. In this paper a long list of swallow-holes is given, showing the nature of the material which enters them. From their distribution it appears that they usually occur where the Tertiary beds rise above the Chalk into well-marked hills, but not where, from having a higher dip, they come to form a level tract with the surface of the Chalk. Two sets of conditions are thus contrasted:—

1. Comparatively high dip of Chalk and Tertiary Beds.
   Small escarpment of Tertiary Beds.
   Junction at a very low level.
   Saturation level of the Chalk at or close to the junction.
   Springs at the junction.

2. Low dip of Chalk and Tertiary Beds.
Marked escarpment of Tertiary Beds.
Junction not at the lowest level.
Saturation level of the Chalk below the junction at the surface.
Swallow-holes at the junction.

Whitaker, W. — The Chalk of the London Basin, pp. 433–435.

***549. Whitaker, W.—On Maps showing the area of Chalk available for Water Supply in the London Basin.**

Trans. Sanitary Inst., vol. xiii. pp. 243–248.

These maps show the areas of—I. bare Chalk; II. Chalk covered by permeable beds; III. Chalk protected by beds of mixed or varying character; IV. Chalk protected by impermeable beds in two subdivisions; IV*a*. those in which the surface streams run towards the Chalk; IV*b*. those in which they run away from it. It is only the areas I., II., and parts of III. and IV*a*. that can contribute water to the mass of the Chalk.

550. Thresh, J. C. — The Shallow and Deep Well-waters of Essex.

Essex Naturalist, vol. viii. pp. 28–40.

The author at present has no evidence that there is any difference between "Bagshot" and "Drift" waters, except such as can be accounted for by the influence of the Boulder-clay, or by contamination. Boulder-clay waters often contain sulphuretted hydrogen, but the analyses do not lead the author to ascribe this to contamination. Waters with much sulphate of magnesia are thought to be derived from small beds of sand in the London Clay; similar water is obtained from deep wells piercing through the London Clay, but it is not quite certain where the ingredients come from. Some wells near Maldon and elsewhere contain salt, but no magnesia; they are soft and pure. The harder waters from the Chalk contain but little sodium chloride or carbonate, which is just the opposite to the waters from other Chalk wells. The author enquires what can be the reason of these differences. As an appendix, seven tables of analyses are given showing the composition of waters from the Bagshots and from the Glacial gravels; of waters containing very little carbonate of lime, and of others with hardness less than five, between five and ten, and over ten; also the variations of water from the same well, and from adjoining wells—185 analyses in all.

551. Middleton, R. E.—Report on an Enquiry into the alleged Depletion of Rivers, Springs, and Wells in Hertfordshire, pp. 540-675. Maps, Plans, and Diagrams to accompany the Report of the Royal Commission on Metropolitan Water Supply.

London, Eyre and Spottiswoode, fol., C 7172 (IV.); price £1.

The maps include a geological map of the Thames and Lea basins, together with the north-east part of the county of Kent, on a scale of four miles to the inch. Plate 1 of sections includes—I. From the North Downs near Caterham, through London to the Chiltern Hills. II. From the North Downs near Westerham, across the river Thames to Purfleet. III. Through North-east Kent from the North Downs near Stouting to Wingham.

***552. Hodson, G. — A consideration of some of the conditions requisite for obtaining Underground Water Supplies: Illustrated by a Description of the Works for supplying Long Eaton and Melbourne, Derbyshire, and Castle Donington, Leicestershire.**

Surveyor, vol. iii. pp. 327–329. Also separately printed: Loughborough, Wills, 8vo, pp. 36, with ten plates and a map.

Read to the Incorporated Association of Municipal and County Engineers. The author commences with an admirable account of the numerous details necessary to be considered in advising a site for a deep boring, particularly whether the water runs off in floods or not, and the existence of unrecorded faults. The previous attempts by a company to supply Long Eaton with water from the Trias [*see* No. **206**, 1892] having failed, ten trial bore-holes have been put down by the author at various points. The strata at Weston were found to be very much cut up by faults, and the present bore-hole is at Stanton Barn on the Millstone Grit area, which has a catchment of seven square miles and slopes towards the site from a height of 200–300 ft. above its level. Here the Upper Millstone Grit is 60 ft. thick, then comes 52 ft. of shale, and the bottom grit occurs at a depth of 194 ft., from which the water rose in a fountain 20 ft. high, and proved to be of excellent quality. A section is given showing the various bore-holes, from which it appears that the succession of beds at Stanton Barn is approximately: Alluvium, 10 ft.; Grit, 60 ft.; Shale, 50 ft.; Grit, 15 ft.; Fireclays, 50 ft.; Grit, 30 ft.; Shale with coal-bands, 35 ft.; Limestone shales, 50 ft. Two faults are shown between this spot and the Midland Railway. None of the other bore-holes reached anything but Keuper Marl. One near Trent lake pierced about 170 ft. of gypseous marls, yielding

water which was practically a saturated solution of sulphate of lime. In an appendix an analysis of the Millstone Grit water by C. M. Tidy is given. "It is very good water indeed."

***553. Hull, E.—Notes on the Water-bearing Capacity of the New Red Sandstone of Nottingham.**

Geol. Mag., Dec. 3, vol. x. pp. 553–555. (Read at Brit. Assoc.)

Mentions the fact of the Bunter being thick, a good water-bearing stratum, and underlain by impervious Permian Marl, as favourable conditions for water supply. It is estimated that 40 million gallons per diem might be drawn from it between Nottingham and Worksop. The supply at Bestwood is decreasing.

554. Goodchild, J. G.—Notes on the Water Supply of Edenside.

Trans. Cumberland and Westmoreland Assoc., No. xvii. pp. 43–51.

Published in 1893. Inserted by error in the "Annals" for 1892.

MINERAL WATERS.

555. Bothamley, C. H.—The Mineral Waters of Askern in Yorkshire.

Journ. Chem. Soc., vol. lxiii. pp. 685–696.

The author has analysed the water from four wells, and finds the following in grains per gallon:—

	Town end.	Terrace.	Charity.	Manor.
Calcium carbonate	58·92	57·62	47·78	46·89
Calcium silicate	1·97	1·83	3·10	3·14
Calcium sulphate	36·55	31·04	34·57	36·06
Magnesium sulphate	27·12	30·02	50·29	47·84
Sodium chloride	2·42	6·92	8·33	8·44
Sodium sulphide	2·98	1·54	4·61	4·19
	129·96	128·97	148·68	146·56
Hydrogen sulphide in cub. in.	15·73	13·74	9·66	10·35

There are also traces of Iodine, Iron, Lithium, and Strontium. The springs are shallow and the water is highly charged with organic matter from the peat. The absence of bromine and potassium is remarkable. The hydrogen sulphide is most abundant in summer, and is thought to be due to the reduction of the sulphates by organic matter.

MISCELLANEOUS.

556. Parry.—Clays, Brick, and Brick-making.

The Surveyor, vol. iii. pp. 215, 216.

Read to the Victorian Architectural and Engineering Association. Gives an account of the several varieties of clay. The worst bricks that have ever come under the author's observation were those made in London.

***557. Metcalfe, A. T.—On the Gypsum Deposits of Nottinghamshire and Derbyshire.**

Privately printed. (Read at Brit. Assoc. Sept. 1893.)

Gives a general description of the mode of occurrence of gypsum, methods of working, and uses of the various kinds. After exposure for twenty-four hours free sulphur is occasionally found on the surface. The following analysis of a Notts sample is given:—

Sulphate of lime	77·37
Carbonate of lime	0·83
Oxide of iron	0·50
Siliceous matter	0·30
Moisture	21·00
	100·00

***558. Cameron, A. C. G.—The Fuller's Earth Mining Company at Woburn Sands.**

Rep. Brit. Assoc. for 1892, p. 711.

Published in 1892 in the Geological Magazine [*see* No. **428**, 1892]. It is here that the greatest thickness of greensand occurs in the Midland Counties.

***559. Cameron, A. C. G.—Geology, Mining, and Economic Uses of Fuller's Earth.**

Trans. Fed. Inst. Mining Eng., vol. vi. pp. 204–209.

Fuller's earth is now used largely for oil-refining in America, and is exported for the purpose from England. Besides the well-known beds of the Jurassic series, a kind of fuller's earth occurs below the Aymestry Limestone in Shropshire, and in "reddle-pits" in Warwickshire and Yorkshire. Also a sandstone at Maxton in Roxburghshire. Besides these there are valuable deposits of fuller's earth in the Lower Greensand of Bedfordshire, the history of the working of which is traced. Woburn earth is yellow and blue, and less calcareous and more ferruginous than that of Bath.

560. Sanford, P. G.—Analysis of the Fuller's Earth of Vrongoch.

Geol. Mag., Dec. 3, vol. x. p. 160.

The bed of fuller's earth examined occurs at Rhiwlas, Vrongoch, near Bala. It is about 60 ft. thick; it dissolves in water to 4 per cent. It is a better absorber of grease than that of Nutford, and is soft and friable.

		A.		B.
Insoluble in acid	$SiO_2=63{\cdot}25$, $Fe_2O_3=8{\cdot}72$, $Al_2O_3=6{\cdot}30$	78·27	$SiO_2=57{\cdot}01$, $Fe_2O_3=$ tr., $Al_2O_3=21{\cdot}25$	78·53
Alumina		12·95		2·84
Ferric oxide		0·42		8·50
Lime		0·82		0·90
Magnesia		1·65		2·30
Sulphuric acid		0·31		0·05
Alkalies		2·02		2·12
Combined water		3·56		4·76
		100·00		100·00

***561. De Rance, C. E.—On the Rolation of Geology to the Population and Agriculture of England and Wales.**

Trans. Manchester Geol. Soc., vol. xxii. pp. 85–109, also p. 182.

This paper consists of the explanation of certain appendices, the first of which gives in a tabular form the relation of area to population, the proportions under wheat, corn crops, green crops, permanent pasture and water, and the proportions of certain groups of geological strata in the several counties. The second gives the increase or decrease of area of the counties, as given in the census of 1891, when compared with previous estimates; and it is noted that 16 out of 18 counties where decrease is observed border the sea. The third gives the percentage of various crops grown in Lancashire and Cheshire compared with the maximum and minimum and average in England and Wales. The fourth gives prices in 1871, 1881, 1891; and the fifth compares prices of consols, and wheat, barley, and oats from 1785 onwards. The proportions under corn, etc., given in Table I. are taken from the old results given by W. Topley from the returns of 1869, and as considerable changes have since taken place, another appendix is added on p. 182 giving the new results of the Board of Agriculture in 1891.

562. Haviland, A.—The Geographical Distribution of Disease in Great Britain.

London, Swan Sonnenschein, 8vo, pp. 486, 2nd ed. (1892).

The first six chapters (pp. 1–138) are mostly occupied with a geographical description of the Lake District; then follows the geological description compiled from various authors, in chapter vii. pp. 139–210. The general conclusion is that disease is more abundant on clay soils, especially if liable to floods, than on limestone rocks.

***563. Miers, H. A., and Crosskey, R.—The Soil in Relation to Health.**

London, Macmillan, small 8vo, pp. 135.

Chapter I. (Rocks and Soils) is an elementary description of some minerals and rocks without any reference to sanitation. In later chapters the connection of disease with the quality and quantity of the underground water and air is traced, and in the last the geographical distribution of disease as dependent on clay, sand, or calcareous soils. The authors "consider Mr. Haviland's data insufficient and his conclusions erroneous" [*see* No. **562**].

564. Whitaker, W.—Local Geology [of Portsmouth] from a Sanitary Standpoint.

Trans. Sanitary Inst., vol. xiii. pp. 256–258.

The alluvium is bad for building on, the Drift is better. The chief water supply is from the Bagshot Sands, but the best is from the Chalk provided the gravel water can be kept out. There is abundance in the Chalk for all the requirements of the town.

***565. Rudler, F. W.—Handbook to the Collection of British Pottery and Porcelain in the Museum of Practical Geology, Jermyn Street, London, S.W.**

London, Eyre and Spottiswoode, 8vo, pp. 178; price 1*s.*

Although this work goes into many interesting details beyond the scope of geology, the chapters on the composition and origin of clays and on raw materials give full information concerning the uses to which different varieties of rock, as clay, kaolin, flint, etc., may be put.

566. Morison, J.—Limestone Mining in Scotland.

Trans. Fed. Inst. Mining Eng., vol. vi. pp. 199–213.

Mostly concerned with methods of working, but sections of the worked portions at the Leavenseat, Burdiehouse, and D'Arcy mines are given.

567. Fream, W.—Peat and its Products.

Journ. Roy. Agricultural Soc., Dec. 3, vol. iv. pp. 751–778.

The account of peat itself is mostly quoted from the writings of well-known geologists, and the rest of the paper deals with the products.

MAPS AND SECTIONS.

GENERAL.

568. Geikie, Sir A.—Annual Report of the Geological Survey and Museum of Practical Geology for the year ending Dec. 31, 1892.

Rep. Science and Art Department. Appendix E., pp. 246–275.

On this occasion, for the first time, geological as well as official information is embodied in this report. The new points are:—

Drift.—There is an old channel 100 ft. deep, and filled with drift, near Walkern, in Hertfordshire. Near Melton there is a boulder of Lincolnshire Oolite at least 300 yards long and 100 yards broad; and a large chalk mass occurs at Catworth [*see* No. **238**]. Ice-scratched rock surfaces, and undoubted Boulder-clay with eskers and kames, indicating a southerly movement of the ice, occur in South Wales.

Tertiary.—The Blackheath Pebble beds and the Bagshot Pebble beds have been observed in Hampshire.

Cretaceous.—The break at the base of the Gault becomes so much more marked westward as "to suggest that the base of the Cretaceous system might have been more suitably drawn at the bottom of the Gault than at the bottom of the Wealden beds," while a conglomerate which forms the base of the Gault is correlated with the Carstone and Folkestone beds, which should therefore be considered Upper Cretaceous. "The faults and foldings of the strata" in the Weymouth district "have been formed at two different periods—the one set affecting the Oolitic rocks, but passing under the Upper Cretaceous strata, without disturbing them; the other breaking through both Oolite and Cretaceous rocks alike."

The Oxford Clay has been previously mistaken for Drift to the north-west of Bedford, and the Cornbrash has been

detected in several new areas; while some parts previously mapped as Lias really expose Great Oolite clays.

Devonian.—Mr. Ussher believes the mica-schists, etc., of Start Point "to be comparable with the Devonian slates and interlaminated grits and shales in the north, though greatly more gnarled and plicated"; there is no dislocation at the junction. "He concludes that in all probability the green rocks, mica-schists, and quartz-schists are really metamorphosed Devonian sedimentary and igneous rocks." The predominant, if not the only, felspar present is albite, and quartz is comparatively rare. Quartz-albite veins have been detected, and certain dolerites have been rendered schistose by dynamic action without the conversion of augite into hornblende.

Lewisian Gneiss.—The platform of gneiss to the west of the overthrust area in Sutherland and Ross is found to be very uneven, so that "mountains of gneiss from 2000–3000 ft. high with wide and deep intervening valleys already existed before the period of the Torridon Sandstone." In the Loch Maree district has been found "a group of rocks quite unlike the usual types of the Lewisian series. They consist chiefly of fine mica-schist, quartz-schist, graphite-schist, and limestone, and may be altered sedimentary rocks." In Guinard and in Rona, definite places are found where the gneiss and its dykes become more finely schistose by elongation under shear.

"*Torridonian.*"—The sandstones of this group "resemble portions of the Old Red Sandstone, with which at first they were identified, and this resemblance extends even to the practical uses that may be made of them." An important group of shales occurs towards the base, and has impure limestone bands in Skye, and a band composed of magnetite and zircon. In the Applecross district these sandstones are pierced by two volcanic necks which may have been produced in Tertiary or any other times.

In the district between Loch Kishorn and the head of Loch Carron "a wide area of Torridon Sandstone and old gneiss has been inverted and pushed bodily westwards so as now to lie upon the Cambrian formations." The Torridon Sandstone, pushed over the quartzites and limestones, dips eastwards for several miles until its base passes under the overturned Lewisian gneiss." The sandstones on the line of the "inverted unconformability" have been crushed and have become partially schistose, and "pegmatite veins of quartz and felspar have been formed by segregation in rents of the strata." The gneiss also, as it is followed eastwards for several miles, appears more and more sheared, until at last it is succeeded by siliceous granulitic flagstones, such as have been called Moine schists: part of these may be a mass of Torridon Sandstone caught and enclosed within a great synclinal fold by the mass of old gneiss as it was driven westward. To the eastward of this zone of probably

clastic material other huge masses of the Lewisian gneiss have been pushed up and more or less deformed.

Eastern Gneiss.—Mr. Horne "regards it as certain that altered sediments form an integral portion of the granulitic schists and gneiss of North Sutherlandshire." But he also finds that these schists and gneisses are traversed by abundant belts and veins of foliated and unfoliated granite, showing no cataclastic structure. From these larger portions of granitic material countless minute folia of the same substance have proceeded along the foliation planes of the schists. Hence three distinct types of gneiss have been produced—(1) Granitoid gneiss or gneissose granite; (2) an intermediate type consisting of alternations of granulitic and granitic materials; (3) well-banded biotite gneiss.

In the neighbourhood of Loch Awe a group of rocks consisting of grits, phyllites, and limestones, which in their unaltered condition resemble ordinary Palæozoic sedimentary strata, have been traced continuously into the crystalline schists of the central Highlands.

In the Southern uplands all the anticlinals show volcanic rocks at the core. A bed of Middle Lias Ironstone has been found in Raasay [*see* No. **512**]. Glacial striæ score the mountain-sides in Applecross up to 2000 ft. in a direction 20°–30° north of west.

ENGLISH MAPS.

Geological Survey Maps—E. Stanford, Cockspur Street, Charing Cross, Agent.

569. Sheet 5.—New Edition. Solid and Drift.

The only alterations in the "solid" map are found in the Chalk area, in which the outcrops of the Chalk Rock and the Melbourn Rock are inserted. Part of the previously coloured Woolwich and Reading beds at Seaford are now referred to the "clay with flints." A small outlier of London Clay is recognized as cutting the hill at Newhaven.

In the "Drift" map no superficial deposits are anywhere inserted except on the Chalk area. These are classed as "clay with flints" and "valley gravels," and are in addition to the former Alluvium. The map uncoloured is a very old one.

570. Sheet 9.—New Edition. Solid and Drift.

In the "solid" map there are many minor alterations. The alluvium of the river valley S.E. of Petworth is restricted to narrower limits, the place being taken by the underlying Cretaceous rocks. The outcrops of the Chalk Rock and Melbourn Rock are inserted. The London Clay between Chichester and Arundel is made to cover a much larger area,

extending to the east of Arundel, and taking the place of the underlying Woolwich and Reading beds. The Bracklesham beds are not now supposed to cross to the north side of Pagham Harbour.

In the "Drift" map no drift deposits are recognized as lying on any beds below the Chalk. Those on the Chalk and Tertiary are classed as clay with flints, marine gravel, Coombe Rock and valley gravel, and brick earth. The Brick earth is entirely confined to areas which reach the coast. It occupies almost all the surface from Chichester to Selsey Bill, but nearly dies away at Worthing. The "Coombe Rock and valley gravel" succeeds the Brick earth to the north. It covers a wide area north and south of Chichester, and runs up into several of the dry chalk valleys or coombs. Isolated patches along the valleys of the Arun and Adur are distinguished by dots, as if they were of a different lithological character. The marine gravel is found only in a few small isolated patches west of Shoreham, one being at Selsey. The clay with flints occurs also in small patches, always on the Chalk. The solid geology *lines* are marked on this map beneath the Drift colours. The map itself is so old that Brighton is printed Brighthelmstone!

571. Sheet 330, New Series.—New Edition. Solid and Drift.

These embody the results already published with regard to the geology of the Isle of Wight. In the Lower Cretaceous the subdivisions for mapping are Wealden Beds, Atherfield Clay, Ferruginous Sands, Sandrock Beds, Carstone. In the Upper Cretaceous the chert beds of the Upper Greensand (or "Freestone and soft sand") and the chalk rock in the Chalk marked i^4–i^7 (or the Bracklesham and Barton series) are all put together, and the largest Tertiary area is occupied by the "Hamstead" Beds. The rocks on the mainland would appear to have no relation to those in the adjacent island, for neither Bembridge nor Hamstead beds are anywhere recognized. Instead of these there is a broad spread of "Osborne and Headon Beds." Only north and west of Brockenhurst, near Barton, in the valley at Lymington and along the east side of Southampton Water, do "Barton Sands" and "Barton Clay" appear.

The Drift deposits recognized are Plateau gravel, angular gravel of the Downs, Gravel Terraces, and Brick earth. The first of these is the most widely spread—occurring in scattered patches on the high grounds of the Isle of Wight, particularly by Hamstead and Cowes, and covering the whole of the mainland, except the branching valleys. The angular gravel of the Downs is only found on the Chalk. The only gravel terraces are at Brockenhurst, Braulieu, and Freshwater, and the brick

earth is only mapped near Milton and at Newport. The localities of Estuarine shells and Palæolithic implements in Stanswood Bay are marked.

572. Sheet 331, New Series.—New Edition. Solid and Drift.

The Cretaceous rocks of the Isle of Wight follow as in Sheet **330**. The Hamstead beds are shown as dying out at Brading, and the underlying Bembridge beds form the surface over many square miles, being a shallow synclinal. The limestones of the Foreland and of Binstead are represented as an episode at the base of this group. On the mainland the whole of Portsmouth is made to stand on the Bracklesham beds, but all the lines downwards to the Chalk are marked as approximate only on the "Drift" map.

The plateau gravels have a considerable area along the N.E. coast of the Isle of Wight, and also in patches on, and south of, the Downs: they observe no level. On the mainland there is also a wide spread at Portsmouth and to the west, but it scarcely extends to the east. On this side the brick earth, which is almost absent in the island, covers nearly all the ground. The gravel terraces are shown only in the valley west of Sandown, and one minute patch on the mainland.

573. Sheet 332, New Series.—New Edition. Solid and Drift.

This is part of the map No. 9, old series, comprising Selsey Bill and Littlehampton. Much more information as to the geology of the coast line is inserted on it. Thus a Pleistocene marine deposit is seen at low-water west of Selsey Bill, and there are here "scattered erratic blocks of granite, gneiss, basalt, schist, quartzite, etc., up to ten tons in weight."

574. Sheet 333, New Series.—New Edition. Solid and Drift.

The map only just catches two land areas at Worthing and Rottingdean. It goes into sheet 5, old series.

575. Sheet 334, New Series.—New Edition. Solid and Drift.

This includes part of Sheet 5, but the Geology in the two sheets does not quite agree, but it is obvious that the present sheet is the correct one. Thus Horsey and St. Anthony's Hill to the north of Eastbourne are marked *h* 4 and *h* 2 respectively in Sheet 5, but both are *h* 3 in this. There is a large patch also of valley gravel at Willingdon not marked in Sheet 5, and many other minor differences.

576. Isle of Wight.—Separate Sheet.

This is composed of sheets 330, 331, 344, 345, and has a general index of colours. It is published both as solid and drift.

***577. De Rance, C. E.—Map of River Basins. England and Wales in County Council Groups.**

Manchester, Cornish.

This map is perhaps rather geographical, or economical, than purely geological, as the formations are not coloured on it; only the water-partings are marked.

577a. Shipman, J.—Geological Sections.

Gaston Freestone, 4, Poultry, Nottingham.

These are thirteen sections on six sheets (price 6*d.* each), showing the various rocks in the neighbourhood of Nottingham, prepared for the British Association on their meeting in that town.

SCOTCH MAPS.

578. One-Inch Geological Survey Maps.—Sheet 8.

This sheet comprises the area between Loch Doon and Loch Ryan in the western part of the Southern Uplands. The bulk of the surface is occupied by "Lower Silurian" or Llandeilo-Caradoc beds. This is flecked over with a number of thin lenticular patches of Black Graptolitic shale which lie like a flight of swallows in undulating streams running approximately E.N.E. There are two principal bands of these towards the south-east side. A vast number of dips are inserted on this area which mostly point N.W. or S.E., but otherwise no indication is given of the structure of the country. In the midst is a large oval patch of granite—with long axis N. and S., culminating in Mullwharchar; and in the south-east corner part of another, including the Cairngmore of Dee; and two smaller patches elsewhere. The sign β^2 instead of b^2 written near the edge is the only sign of the extent of metamorphism observed. The north-west corner of the map is separated from the rest by a fault marked as hypothetical. On the other side of this the lenticular patches consist of Radiolarian chert, each of which has a central core of diabase. Further N.W. there are similar patches of limestone and graptolitic slates. All these are faulted against a strip of Upper Silurian, and overlain by irregular areas of Old Red Sandstone and conglomerate intermixed with

contemporaneous porphyrite and ashes and intrusive felsite and dolerite. In the extreme N.W. is a faulted area showing Calciferous Sandstone and Carboniferous Limestone.

A considerable portion of the area is covered by peat, but the bare rocks have yielded many glacial striæ. These, with very few exceptions, are in relation to the central granite mass, from which they radiate. It is only where this faces N. that there are any north-running striæ; from the other three sides there is always a southern direction, *i.e.* the average is S.E. on the east side and S.W. on the west side. The striæ are especially numerous on the south and south-east sides; but they seem to take no notice whatever of the lower granite mass in the south-east corner. On this mass, however, no striæ are marked; but on the central mass the present summit forms a parting, the striæ running, with the exception of a local eddy, north and south from it.

579. Sheet 91.

This includes Loch Gairloch and Loch Ewe. The bulk of it is occupied by "Torridonian" and "Lewisian gneiss." The Torridonian is divided into two parts: the upper is the Torridon Sandstone, and the lower "grey grits, dark shales, and breccias." The latter are only found south of the north shore of Loch Gairloch, surrounding the Lewisian gneiss. Elsewhere the upper part comes in unfaulted, unthrust contact with the same group. The Lewisian gneiss series consists of "massive and foliated hornblendic, pyroxenic, and micaceous rocks," in the midst of which and running parallel to each other, like vertical beds, are represented innumerable lines of "epidiorite, foliated or unfoliated," which are said to be intrusive. In the centre of the main Lewisian area, which has a general direction N.N.W., runs a larger mass of the same rock, which itself surrounds a long narrow patch of mica-schist, associated with which along the edge of the epidiorite is a broken band of limestone, and near it some bands of graphitic schist. No definite thrust planes are here indicated, but there are numerous yellow lines, explained as "lines of pre-Torridonian crust and deformation," *i.e.* they run up to and never enter the Torridon Sandstones. In the north-east corner, there is a band showing Trias lying on Torridon Sandstone, and followed by Lias, which is then faulted down against the Torridon Sandstone on the S.E. Numerous glacial striæ are marked, but beyond having a general northward tendency, no particular relation can be made out.

FOREIGN GEOLOGY.

(*Published in Britain.*)

PHYSIOGRAPHY.

580. Ogilvie, Maria M.—Landslips in the St. Cassian Strata of S. Tyrol.

Rep. Brit. Assoc. for 1892, pp. 721, 722.

The nature and causes of these landslips is dealt with: their effects are the mixture of the surface blocks of various strata, so that the stratigraphical sequence can only be determined where the rocks have not slipped.

581. Cumming, L.—Some observations on Mountain Débris.

Proc. Liverpool Geol. Soc., vol. vii. pp. 87–94.

A description of some fans in the Dauphiné district, and speculations as to their origin.

582. Preller, C. S. Du Riche.—On the Origin of the Engadine Lakes.

Geol. Mag., Dec. 3, vol. x. pp. 448–452.

The lakes of the Engadine are on the course of the Inn, but that river rises very little beyond the highest, so that no river now exists which is capable of having eroded the valley and of laying down the alluvium which is found in it. On the other side of the watershed, south of the Engadine and Bargalia valleys, however, there are three streams, the Meira, the Albigna, and the Orligna, which run at first in the direction of the Inn, but subsequently turn an angle and empty into the main Meira stream, which flows down Bargalia. It has, therefore, been already concluded by Prof. A. Heim that these three streams were formerly tributaries of the Inn, but that they have since been deflected to the Meira, by the receding of its divide. The cause of this recession, according to him, is the backward erosive action of the Meira; but the author thinks that its erosive power would be quite insufficient to excavate a mountain barrier of gneiss 6600 ft. in vertical height, and suggests that "the deflections can only have been produced in the first instance by the subsidence of the old divide," followed by erosion. The power of the Inn having been thus destroyed, its valley has become choked at various points by the detritus brought down by its tributaries, and hence the lakes in the intervening areas.

***583. Preller, C. S. Du Riche.—Note on the Lakes of Zurich and Wallen.**

Geol. Mag., Dec. 3, vol. x. pp. 222–225.

These two lakes were at one time united, but the intervening area has been silted up by the tributary Linth. They are too deep—560 ft. and 460 ft.—to be due to glacial erosion, but must lie along an ancient fissure. The Lake of Zurich owes its purity to the slow passage of water through it, so that the sunshine, the motion of the surface, and vegetable organisms have time to purify it. The river Sihl probably flowed into it at one time at the tongue of Hurden, where there are deposits not found elsewhere along its border.

584. Davison, C.—Note on the Growth of Lake Geneva.

Geol. Mag., Dec. 3, vol. x. pp. 454, 455.

The author draws attention to some observations made by M. Plantamour at Sécharon, near Geneva. He fixed E. to W. and N. to E. levels in the cellar of his house and observed their change. The east and west changes may be due to expansions and contractions, and to settling of the ground, but the north and south ones can scarcely be so explained. There has been an average "change of inclination towards the north" of $1''\cdot52$ per annum, and this would result, if continued, in an enlargement of the lake.

585. Brown, H. T.—Notes on a Summer Tour in Norway.

Trans. Burton-on-Trent Nat. Hist. and Arch. Soc., vol. ii. pp. 70–89.

The mountains of Scandinavia are not due to earth crumpling, but have been cut out of a vast elevated plateau. The origin of the fjords and of the pierced rock of Torghatten is discussed.

586. Blytt, A.—On some Calcareous Tufas in Norway.

Rep. Brit. Assoc. for 1892, pp. 714–716.

In Gudbrandsdal, near the Dovrefeld, beds of tufa of various characters are found overlying, and separated by, unfossiliferous clays. The lowest tufa is full of leaves of *Betula*, the next of *Dryas*, and the highest of pine. The same succession, except as to the *Dryas*, is found further down the valley. From these facts the author concludes that we have here a climatal chronology, the underlying beds being Boulder-clay, the whole is post-Glacial, and the tufas indicate wet periods and the clays dry periods, while the time which has elapsed between one tufa and another has been sufficient to change the prevalent plants: these changes the author thinks to be due to cosmical causes.

***587. Lake, P.—The Growth of the Indian Peninsula.**

Geol. Mag., Dec. 3, vol. x. pp. 309–314.

This paper deals with the whole of India south of the Indo-Gangetic plain. There are three main areas of gneissose rocks, viz. the Southern mass, the Bundelkhand mass, and the North-eastern mass, and through the union of these by newer formations the peninsula has been built up.

Pre - Gondwàna History. — The southern mass was once entirely covered by the Dharwar series. These were folded and denuded, and afterwards on the eastern side the Kadapah series was deposited, and Kaladji rocks on the north. Since these were deposited, the area has remained land. The Bundelkhand mass is bordered on the S.S.E. by the Bijawar deposits, and on the north by other pre-Vindhyan beds. In both these cases the rocks have been subsequently crushed against the gneiss. Of the North-eastern mass less is known.

Gondwàna History.—Later rocks filled the spaces between the folds and the old shore lines, and at the beginning of the Gondwàna period comparatively narrow spaces were left between the three masses, and in these spaces the Gondwàna rocks were deposited—and thus completed the union between the three elements of the peninsula. As no later marine beds are known, the area must have remained dry land ever since.

Post-Gondwàna History.—The outflow of the Deccan Trap has changed the configuration of the surface, and the occurrence of marine Jurassic and Cretaceous rocks on the coasts shows that the land has risen since Gondwàna times. No such rocks, however, occur on the western side of the Southern mass, which indicates that the land during those periods extended further to the south-west (*cf.* "Lemuria"), and has only been partly submerged in Tertiary times.

***588. Ball, V.—On the Volcanoes and Hot Springs of India, and the Folk-lore connected therewith.**

Proc. Roy. Irish Acad., vol. iii. pp. 151–169.

A general notice of the volcanoes (of which there are none on the mainland) and supposed volcanoes, and of the hot springs and the myths which the natives connect with them. It is suggested that the plants which flourished in the neighbourhood of the hot springs in early geological periods may erroneously have given rise to an idea of a more tropical climate at those periods than is necessary to account for them.

***589. Ball, V.—The Volcanoes of Barren Island and Narcondam in the Bay of Bengal.**

Geol Mag., Dec. 3, vol. x. pp. 289–291, plate xiii. [Third Notice.]

A picture of Barren Island is here given which has been produced by making a model partly from the data in F. R. Mallet's description and partly from personal observations, and then photographing the model. Its interest lies in the island containing a cone in the centre of its crater, and thus resembling the lunar mountains. This island volcano was in eruption at the end of last century, consequently its fauna is very limited.

The similar island volcano of Narcondam is extinct, and it contains a hornbill, probably from the mainland of Further India, which has changed its specific characters since its arrival. There are also rock-swiftlets, flying fox, and rats.

590. Sieger, R.—The Rise and Fall of Lake Tanganyika.

Quart. Journ. Geol. Soc., vol. xlix. pp. 579–582.

The author does not dispute the local conditions described by Mr. Carsson [No. **463**, 1892], but thinks the changes of level are mainly due to a wider-acting cause, namely, changes of climatic conditions, which have a certain period in Africa. Thus, the damming up of the Lukuga takes place when the rainfall is small, and the clearing it out when the rainfall is great. Hence the phenomena are meteorological rather than geological.

STRATIGRAPHICAL GEOLOGY—EUROPE.

591. Ogilvie, Maria M.—Contributions to the Geology of the Wengen and St. Cassian Strata in Southern Tyrol.

Quart. Journ. Geol. Soc., vol. xlix. pp. 1–77, with 7 folding maps and sections.

The authoress first gives an account of previous work in the district.

The Triassic strata exposed in the district examined are, in descending order:—

8. Dachstein Dolomite.
7. Raibl Beds.
6. Schlern Dolomite.
5. St. Cassian Beds.
4. Wengen Beds.
3. Buchenstein Beds.
2. Muschelkalk.
1. Weifen Beds.

The description of these is given in three distinct areas, of which the first is that of Corvara, Prelongei, and Sett Sass. In this area only the five lower members of the series occur, and comparative detailed sections are given in these three localities of Nos. 5 and 4, in 12 to 15 subdivisions. These divisions are grouped as Lower and Upper Wengen, and Lower and Middle St. Cassian. The three lower groups are feebly developed in

the south part of the area. The beds called No. 11, consisting of marls and oolitic limestones, are the most prolific in St. Cassian fossils. In the Sett Sass district the fossiliferous St. Cassian is seen to underlie the dolomite conformably. The massive limestones at the base of the St. Cassian beds are comparable with the Cipit limestone of the Seisser Alpe, and this horizon is accepted as the best stratigraphical limit between the Wengen and St. Cassian beds. There is also an inconstant "Cipit Kalk" at a higher horizon. The Wengen beds are divisible into two portions—the lower with *Halobia Lommeli* and much augite porphyry; the upper with *Posidonomya Wengensis*.

The district of Abtey Valley, lying to the north, is then described, where Upper St. Cassian beds are developed which are known as "Heilig Kreuts strata," from the occurrence of the Heilig Kreuze slope. These have been considered to belong to the Raibl series, the Schlern dolomite being here absent, but from a comparison of the fossils the authoress considers them to be true St. Cassian, and to be succeeded unconformably by the Raibl. Some of the species of fossils, however, are also found in the Raibl.

The next district described is that of the Cortina d'Ampezzo, with the Falzarego Valley. Here all three subdivisions of the St. Cassian are seen, the upper portions containing *Ptychostoma pleurotomoides* and *Naticopsis neritacea* in common with the Heilig Kreuze strata. Their fauna has been but little known, and they have mostly been included in the Wengen strata by Mojsisovics.

The next district is that of the Dürrenstein Massif. The strata here discussed are those of the Seeland Valley. These are fossiliferous marls and shales, with thick limestones containing corals and sponges, as well as unfossiliferous beds. They dip under the Schlern dolomite, which itself dips under the Raibl beds. Their fauna is composed of St. Cassian and other species, many belonging to the Stuores fauna, so they are mapped as St. Cassian, including the upper part. Similar strata occur on the Misurina Alpe and on Flodger Wiese.

The strata of the Seisser Alpe are considered to belong to the Middle and Lower St. Cassian, as well as to the Wengen, to which Mojsisovics referred them all because "St. Cassian fossils form the bulk of the fauna." These are the Cipit limestones, while the Wengen are a thick ashy series with augite-porphyry flows.

The Schlern dolomite is seen in these districts to be 1000–2000 ft. thick, but further south it reaches 3000 ft., while elsewhere it disappears. The most characteristic of the few fossils is *Gyroporella annulata*.

The Raibl strata are subject to much local variation; and details are accordingly given in Sett Sass, Heilig Kreuz, Falzarego, Cortina Plate Wiese, Dürrenstein, and the Schlern plateau. They have a thickness of a few hundred feet, and

the lower part is dolomitic. The Dachstein dolomite is several thousand feet thick: it is always well stratified, and fossils are common but of few species; the most characteristic is *Megalodon triqueter*.

The authoress has collected 345 species from the St. Cassian strata, which are enumerated in a table, in connection with a generalized table, and the following conclusions are enunciated:—

1. The St. Cassian beds are present throughout a wide extent of country, from the Seisser Alpe in the west, to the Mesurina and the Seeland Alpe in the east.

2. In the west only the lower and less fossiliferous horizons of St. Cassian strata are present: the typical Stuores or Middle St. Cassian is first completely developed in Enneberg, while above it there succeeds at Cortina, Mesurina, and the Seeland Alpe a fossiliferous Upper St. Cassian zone.

From the table of fossils may be gathered the following results:—

Species peculiar to Wengen Beds.—Cephalopods 2.

Species peculiar to Lower St. Cassian Beds. — Sponge 1, Brachiopod 1, Cephalopods 2.

Species peculiar to Middle St. Cassian Beds. — Sponges 8, Corals 16, Echinoderms 9, Brachiopods 20, Lamellibranchs 27, Gasteropods 68, Cephalopods 13.

Species peculiar to Upper St. Cassian Beds. — Sponges 6, Corals 11, Echinoderms 4, Brachiopods 6, Lamellibranchs 22, Gasteropods 25, Cephalopods 2.

Species common to Wengen and Lower St. Cassian only.— Lamellibranch 1.

Species common to Lower and Middle St. Cassian only.— Sponge 1, Cephalopod 1.

Species common to Middle and Upper St. Cassian only.— Sponges 6, Corals 16, Echinoderms 8, Brachiopods 5, Lamellibranchs 11, Gasteropods 22, Cephalopods 2.

The remainder are common to more than two divisions of the series. The chapter on the Teutonic relations deals with details of the numerous faults which occur in the district, by means of which it is attempted to account for the anomalous positions of several of the strata, and other difficulties that have occurred in their interpretation.

***592. Prestwich, J.—On the Evidences of a Submergence of Western Europe and of the Mediterranean Coasts, at the close of the Glacial, or so-called Post-Glacial Period, and immediately preceding the Neolithic or Recent Period.**

Phil. Trans., vol. clxxxiv. A, pp. 903–984, plate 33, and abstract in Proc. Roy. Soc., vol. liii. pp. 80–89.

This is an extension to Europe generally of the author's hypothesis expounded in No. **156**, 1892. His "personal observations are limited to parts of France and Italy," the remaining countries being dealt with by quotations from the writings of other authors.

An account is first given of coast sections of France. At Sangatte a raised beach is buried under "head," irregularly stratified, the uppermost bed being massive and "the one which has been propelled to the greatest distance." At Abbeville the "rubble drift" is divided into three portions, which are said to "correspond with three main upheavals," and the idea is expressed that the finer beds are the result of gentle, and the coarser of more violent upheavals. In the Channel Islands the raised beaches are overlain by "head," while all over the 300–350 ft. plateau there are deposits of "loess or brick earth" from 5–10 ft. thick. It is pointed out that these cannot be the deposits from streams, since there are no greater heights from which such streams might run; nor can they have been formed before the separation of the islands from the mainland, because the underlying raised beaches are continued all round the present coasts [*cf.* No. **228**]. This loess, at a later date, "as the land rose," has been carried down into the valleys. In Jersey the "head has been propelled from its base" for some distance. Similar phenomena are recorded by various authors in Brittany and on the coast to the south.

The inland forms of the rubble drift in France and Belgium embrace—(1) high-level loess; (2) angular drift on slopes; (3) ossiferous breccias. The origin of the European loess generally is here discussed: all the river theories are rejected as regards its higher portions, even if supplemented by supposed changes of level or by damming back by ice. The Eolian theory of Richthofen is admitted (in a postscript) for China, but rejected for Europe, because the loess is thinner, is not found at so high a level, and it exhibits traces of water action. The contained bones are always single, and the climatal conditions were different. The author considers the loess to have been formed during gradual submergence, the material being derived from the rivers whose sediments would surcharge the water as the flood advanced. This submergence is believed to be one of 1500–2000 ft. On emergence some part would be swept to lower levels, leaving some tracts bare. The rubble drift on slopes at Namur, the trou du Frontal in the Paris basin, the Montagne, Genay, and Mentone, and the sub-fossil wood of Dexmont are then noted.

The ossiferous fissures in the Mediterranean coasts occur on detached hills, whence there would be no retreat in case of submergence, and of this statement examples at Nice, Pédémas, and Santenay are quoted. The bones in these fissures are isolated ones, and have been acted on by water, and the only

method, according to the author, by which this could be brought about is by a destruction owing to submergence, and a washing down of the bones into the fissures on emergence.

Notices of raised beaches in Spain and Portugal are next given, and then the ossiferous fissures of Gibraltar are discussed. Here fifteen kinds of animals, belonging to different orders, have been found crowding together, which could not take place under ordinary circumstances, but which must be the result of some great and common danger, such as the gradual encroachment of the sea. The deposits described by Ramsay and Geikie as overlying the raised beach are interpreted as rubble drift, and the huge blocks contained in them are referred to the action of the sea. It is noted also that Mr. Smith, of Jordan Hill, records sea shells here up to 600 ft. Similar phenomena are then quoted in Corsica, Sardinia, Minorca, and Majorca. *Lithodomus* perforations occur at Genoa at 82 ft., and a raised beach at Leghorn at 25 ft. above sea-level. Foraminifera are also found at high levels in Ischia, and there is a raised beach at Capri 30 ft. above sea-level.

Similar facts are noted in Sicily, particularly at Palermo, where the bone cave of San Ciro occurs. Here a bone breccia overlies sea sand. The bones are for the most part of Hippopotami, and have apparently been neither rolled nor gnawed, and amongst them are the bones of fœtuses. Here, again, the author argues that the circumstances which brought together so many animals must have been extraordinary ones, and an incursion of the sea, or its equivalent, a submergence of the land, is the most suitable to account for it; the precipices behind preventing the escape of the animals. On emergence great stones fell down on them from the heights above, and all this must have happened during a short interval of time. These bone breccias are thought to be independent of the caves, whose entrance they mark. Similar remarks are made about the bone breccias in the fissures of the Maltese rocks, and some notes are added about the fissures in Carniola, Itrea, and Dalmatia; also on the red earth and bone breccias of Greece and Crete, where there are raised beaches at 100 ft.; and of Asia Minor, Cyprus, and Palestine. The survey is then continued to the north of Africa, Oran, Algeria, Constantine, and Tunis, all of which districts show either raised beaches or bone breccias. Evidence from Egypt to the same effect does not appear to be forthcoming; but even here there are indications of recent changes of level.

In the "Conclusions," the general explanation of these facts is discussed. The absence of marine shells is accounted for, as before, by the short period during which the supposed changes were effected. Great stress is laid on the water-worn condition of the remains, their local character, and the absence of fluviatile remains. The shortness of the period, as compared with some

estimates, is also indicated by the absence of all sedimentary deposit, and by the slight advance made by man in the interval between the early Quaternary period and the early Stone period. The map indicates the position of the localities referred to.

***593. Preller, C. S. Du Riche.—Note on the Tuscan Archipelago.**

Geol. Mag., Dec. 3, vol. x. pp. 272–275.

Gives an account of the geology of the islands forming the Archipelago. An Italian Geological Survey Map of the Island of Elba has recently been published.

***594. Cooke, J. H.—The Marls and Clays of the Maltese Islands.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 117–128.

The marls and clays are the middle group of the five into which the Maltese deposits were divided by Dr. J. Murray [No. **665**, 1890]. They are not easily separated by a distinct line from the underlying Globigerina limestones. Their thickness varies from 50 ft. to 3 ft., as they are often squeezed out by the weight of the overlying rocks. In some places, however, they form taluses on the hill slopes, which give an appearance of much greater thickness. Foraminifera are abundant, as are crystals of selenite, and in places there are pholas-bored concretions. The molluscan remains have been converted into ferric oxide, which renders them indeterminable; but the author gives specific names to 34, and adds 27 named Foraminifera to those in Dr. Murray's list.

STRATIGRAPHICAL GEOLOGY—ASIA.

***595. Bulman, G. W.—On some Recent Investigations of the Geology of the Punjab Salt Range.**

Knowledge, vol. xvi. pp. 137, 138.

Draws attention to Mr. Middlemass' description of this region in the Records of the Geological Survey of India; commenting on the undisturbed character of the continuous sections here seen, from the Cambrian to the Tertiary, and discussing the nature of the red marl of the salt-bearing series.

***596. Hull, E.—Outline of the Geological Features of Arabia, Petræa, and Palestine.**

Proc. Geol. Soc., Session 1892, 3, pp. 2, 3.

The author here gives a general view of previously noted conclusions.

The most ancient rocks are of Archæan age, and occur in the south; next come the Lower Carboniferous rocks of the Sinaitic peninsula and of the Moabite escarpment, the lower, arenaceous, portion of which the author distinguishes as the Desert Sandstone, the upper being fossiliferous limestone. The overlying Nubian Sandstone is of Cretaceous age, and is followed by marls and flinty limestones. The Middle Eocene, or nummulitic limestone, appears to follow without any stratigraphical, though with a complete palæontological break. The higher terraces of the Jordan-Arabat valley were formed during a depression in Pliocene times, and later ones at the epoch of the glaciation of the Lebanon Mountains. The volcanoes of Jaulân, Haurân, and the Arabian desert commenced eruption in the Miocene epoch, and the date of their comparatively recent extinction is unknown.

***597. Hull, E.—On the Physical Geology of Arabia, Petræa, and Palestine.**

Rep. Brit. Assoc. for 1892, p. 718.

In this abstract no information is given, but only an outline of the contents of the author's paper.[1]

598. Henslow, G.—The Botany and Geology of Egypt.

Fifteenth Annual Rep. Ealing Micr. and Nat. Hist. Soc. for 1891, pp. 27–30 (published in 1892).

Abstract of a lecture giving a general sketch of our knowledge.

STRATIGRAPHICAL GEOLOGY—AFRICA.

***599. Gibson, W.—Geological Sketch of Central East Africa.**

Geol. Mag., Dec. 3, vol. x. pp. 561–563. (Read at Brit. Assoc.)

The district described lies inland from Mombasa. Near the coast is coral rock, which rests on sedimentary shales, limestones, flaggy sandstones, grits, and conglomerates, dipping gently to the east, and extending inland about 47 miles. *Ammonites* and *Ichthyosaurus* have been found in them. They rest unconformably on a metamorphic series of gneisses, schists, and intrusive granites, all intensely folded. They have been much denuded, and cover nearly two-thirds of the area examined. The remainder is formed of volcanic rocks, which rise into the high summits of the district, as Kilimanjaro, etc., or are arranged in lines running north and south. Kilimanjaro

[1] Since printed, in French, for the Intern. Geol. Congress, Zurich.

and the Kyulu Mountains are formed of basic rocks, which do not extend far, while the lavas of Lykipia and of the main plateau are chiefly acid and extend for great distances. They commenced eruption earlier than the basic ones, and continue to be erupted to the present day.

600. Dunn, E. J. — Palæozoic Glaciation in the Southern Hemisphere.

Nature, vol. xlviii. pp. 458, 459.

The author recounts the observations he has made and published on this subject, viz. those on the Dwyka conglomerate of South Africa; the Worragee and the Wild Duck Creek conglomerates of Australia, and of Mount Reid in Tasmania.

STRATIGRAPHICAL GEOLOGY—AMERICA.

***601. Collins, J. H.—Geological Notes on the Bridgewater District in Eastern Ontario.**

Proc. Geol. Soc., Session 1892, 3, p. 6.

The plateau of the Bridgewater district consists chiefly of gneiss, etc., with white marble, conglomerate, quartzite, and veins of giant granite. The frost splits off flakes, especially from the bare glaciated surfaces, and lakelets may be thus originated. The economic products are noted, particularly a kind of asbestiform actinolite rock.

602. Iddings, J. P. — The Dissected Volcano of Crandall Basin, Wyoming.

Geol. Mag., Dec. 3, vol. x. pp. 559–561. (Read at Brit. Assoc.)

The area described is part of the great belt of igneous materials in the Alsaroka range; and the Crandall basin is one of a chain on the north and east of the Yellowstone Park, all of which show a crystalline core and radiating dykes. They are of post-Laramie age. The fresh eruptions of andesite were followed by those of basalt in great quantities, and these by others of andesite and basalt like the first. The area was then eroded and afterwards flooded by rhyolite, which now forms the Park plateau. Round the margin of the district the tuffs and breccias are very thick, and are intercalated with massive lava-flows. The central portion consists of chaotic accumulations of scoriaceous breccias and massive flows. The dykes radiate from three centres, the principal one of which consists of granular gabbro graduating into diorite. The original height of the volcano above the limestone floor was more than 13,400 ft.

***603. Gresley, W. S.—3000 ft. of Quaternary and Tertiary? Deposits in Texas, U.S.A.**

Geol. Mag., Dec. 3, vol. x. p. 92.

Records a section made at Galveston, the deepest on the U.S.A. seaboard. "Sea shells" were found at various depths down to the bottom.

***604. Wallace, A. R.—The Supposed Glaciation of Brazil.**

Nature, vol. xlviii. pp. 589, 590.

The author once accepted the statements of Hartt and Agassiz that there were plenty of characteristic boulders in Brazil; but Prof. Brunner, who has worked longer in the country, now assures him that they are all the result of subaerial decay, and that Hartt had come to recognize this before his death. The blocks are either the relics of decomposition of the main gneisses or their dykes, or they are only consolidated parts of soft superficial deposits of which the remainder has been washed away.

STRATIGRAPHICAL GEOLOGY—AUSTRALASIA, etc.

***605. Wallace, A. R.—The Recent Glaciation of Tasmania.**

Nature, vol. xlix. pp. 3, 4.

Quotes a paper by R. M. Johnson to the Royal Society of Tasmania giving accounts of the unequal glaciation there. From these he concludes that there may be lakes like St. Clair due to damming up, etc., but that there are plenty of true glacial lakes in the western valleys, surrounded by all the marks of the action of ice.

606. Frederick, G. C.—Geological Notes on certain Islands in the New Hebrides.

Quart. Journ. Geol. Soc., vol. xlix. pp. 227–279.

The islands of the New Hebrides lie on a bank separated by a deep submarine valley from New Caledonia. Tanna is of volcanic ash, and rises to a height of 1000 ft.; it is in constant eruption. Efate Island is 24 miles by 18 miles, and rises to a height of 2203 ft.; it is entirely of coral rock, actual coral being found up to 1500 ft.; on the sides there is a series of terraces. Off the island living *Oculina* have been dredged from 40 fathoms. Matorso is 1664 ft. high, and very steep; it is of volcanic origin, as are also Makura and Mai. Near the latter there is an atoll called Cook's Reef. The Shepherds' Islands

are the remains of a volcanic island shattered to pieces some 200–300 years ago. On Tongoa there is an area of hot ground, the temperature of which is probably above 100° C. In Mallicola there are both coral and volcanic formations. For descriptions of the rocks see Nos. **678** and **679**.

VERTEBRATE PALÆONTOLOGY.

*607. Evans, A. J.—On the Prehistoric Interments of the Babzi Rosse Caves, near Mentone, and their relation to the Neolithic Cave Burials, of the Finalese.

Journ. Anthrop Inst., vol. xxii. pp. 287–306.

The author gives a general account, with drawings of the implements and ornaments. He considers the latter in some detail, and compares them with more Northern relics. The Mentone remains are regarded as Neolithic, but as of an earlier Neolithic stratum than any of which we have hitherto possessed authentic records.

608. Evans, A. J.—The Man of Mentone.

Nature, vol. xlix. pp. 42–45.

A resumé of No. **607**.

609. Cooke, J. H.—The Har Dalam Cave, Malta, and its Fossiliferous Contents, with a Report on the Organic Remains, by A. S. Woodward.

Proc. Roy. Soc., vol. liv. pp. 274–283.

The cave is in the Har Dalam Gorge, near Marsa Scirocco Bay, on the east side of the island. It has a main gallery 400 ft. long, with trenches beyond bringing the total to 700 ft. The principal trench opened shows:—

	ft.	in.
Floor earth with boulders	0	4
Red clayey loam with *Hippopotamus Pentlandi* pottery, etc.	3	0
Black earth	0	4
Dark-red purple clay with *H. Pentlandi*	1	6
Reddish clay with small *Hippopotamus* and *Elephas mnaidriensis*	1	0
Yellow plastic clay	2	0

The author concludes that the cave has been partly formed by marine erosion when the land was at a lower level, and partly by streams of greater volume when it was at a higher level, and that the animals have been drowned by an inundation.

The organic remains consist of: *Hippopotamus Pentlandi* and small sp.; *Ursus actos*, jaw; *Canis*, tooth; *Elephas mnaidriensis*, molar and humerus; also cervine and human remains.

In the superficial deposits are found pottery, sheep, bos, and antlers and jaws of *Cervus elaphus* var. *barbarus.*

610. Cooke, J. H.—On the occurrence of *Ursus ferox* in the Pleistocene of Malta.

Geol. Mag., Dec. 3, vol. x. pp. 67–69.

The bones already obtained from Malta have been observed to have been gnawed, but up to this time nothing but one small carnivorous canine has been found. In the Har Dalam cave, however, a ramus of the lower jaw, with teeth, has been found, which is referable to *Ursus ferox*. There are also four canine teeth, one of about the size of a wolf's. The associated bones, nevertheless, are not gnawed, and the deposits being stratified, it is concluded that they were introduced into the caves during floods.

611. Major, C. I. Forsyth.—On *Megaladapis madagascariensis*, an extinct gigantic Lemuroid from Madagascar.

Proc. Roy. Soc., vol. liv. pp. 176–179 (abstract).

The skull here described is from a clayey deposit on the south-west coast, considered to be very recent on account of the associated fauna, and to have been contemporary with man on account of the presence of domestic cattle. This skull has very thick bones, and the sutures are obliterated. The anterior, inter-orbital portion of the frontals has an enormous lateral development extending over the small thick-walled orbits; the post-orbital frontal and parietal regions narrow. Sagittal crest thick and flattened, occipital crest strongly developed, zygomatic arch high, brain-case small, low, and short, cranio-facial angle very obtuse, opening upwards. The resemblances between this skull and those of the Howlers and Marsupials are considered to be merely isomorphisms, as the molars indicate a much specialized Lemuroid, of three times the size of any existing ones. Its specialization is not primitive but retrograde. It constitutes a new genus, species, and family.

612. Anon.—A new Lemuroid Mammal from Madagascar.

Geol. Mag., Dec. 3, vol. x. p. 336.

The specimen described above in No. **611** is now in the British Museum.

613. Major, C. I. Forsyth.—On a sub-fossil Lemuroid Skull from Madagascar.

Proc. Zool. Soc., 1893, part iii. pp. 532–535.

This specimen is from a marsh, and is an imperfect cranium, comparable with *Hapalemur simus*, but about one-third larger,

and the breadth of the cranial capsule almost double. No name is assigned to it.

***614. Marsh, O. C.—Restoration of *Mastodon americanus*, Cuvier.**

Geol. Mag., Dec. 3, vol. x. p. 164, plate viii.

The restoration given is $\frac{1}{30}$ of the natural size; it is from the most perfect skeleton yet known, now preserved in the Yale Museum. The animal stood 12ft. in height, and measured 24ft. to the end of its divergent tusks. There were no inferior tusks. The new anatomical details will be discussed elsewhere.

615. Earle, C.—The Evolution of the American Tapir.

Geol. Mag., Dec. 3, vol. x. pp. 391–396.

The tapir is not a recent introduction on the American continent, as once supposed, but it has been traced back to *Protapirus* in the Lower Miocene of Western Dakota. Thence the author now traces it to the genus *Systemodon* in the Wasatch beds, the *Isectolophus* of the Wind River beds being possibly an intermediate link. These correlations depend on a study of the development of structure in the molar teeth, which shows also that it is wrong to consider *Helaletes* the original ancestor, as that genus leads to *Colodon*.

616. Osborn, H. F.—*Protoceras*, the new Artiodactyle.

Nature, vol. xlvii. pp. 321, 322.

The skull of this animal has been found in the Miocene of America. It has four protuberances on each side of the skull; they are not horn-cores, but like those of *Sivatherium*. The female skull has also been found having a pair only of very small protuberances on the parietal bone, but otherwise agreeing with the male. The premaxillaries are edentulous, but in the lower jaw there are four small teeth shaped like incisors. The upper canines are large, pointed, and recurved. The molar teeth are brachyodont. Three figures are given.

617. Osborn, H. F.—*Artionyx*, a clawed Artiodactyle.

Nature, vol. xlviii. pp. 610, 611.

The foot was found in the same beds as the skull called *Protoceras*. It is the counterpart of that of *Chalicotherium*, but artiodactylate, *i.e.* the front digit is much shorter than the rest. The remaining four are nearly symmetrically placed on either side of the median line.

***618. Marsh, O. C.—Restoration of *Coryphodon*.**

Geol. Mag., Dec. 3, vol. x. pp. 481–487, plate xviii.

The author gives an outline of the American literature of the genus, principally from the point of view of a comparison of his own contributions with those of E. D. Cope. The restoration is from the type specimen and various scattered bones, aided by others from allied species. It represents the animal as having no clavicles, and the fore and hind limbs digitigrade.

619. Major, C. I. Forsyth — On some Miocene Squirrels, with remarks on the Dentition and Classification of the *Sciurinæ*.

Proc. Zool. Soc., 1893, part i. pp. 179–215, plates viii., ix.

This paper is mostly concerned with the latter part of the subject. The new Miocene species described are *Xerus grivensis**, sp. nov., and *Sciuropterus albanensis**, spec. nov., from Isère, represented by molar teeth.

620. Stirling, E. C.—The Discovery of *Diprotodon* and other Mammalian Remains in South Australia.

Proc. Zool. Soc., 1893, part iii. pp. 473, 474.

A large number of skeletons have been found in Lake Mulligan, a dry salt lagoon, in Pliocene deposits.

621. Shufeldt, R. W. — Comparative Osteological Notes on the Extinct Bird *Ichthyornis*.

Journ. Anat. and Phys., vol. xvii. pp. 336–343.

A comparison is made between the skulls, sacra, and femora of *Ichthyornis dispar*, *Rhyncops nigra*, and *Sterna macrura*, and it is concluded therefrom that as far as these structures go the extinct form had more in common with the *Rhyncopidæ* than with the *Sterninæ*. In other structures, however, the fossil form departs widely from both existing types.

***622. Hurst, C. H.—The Digits of a Bird's Wing: a Study of the Origin and Multiplication of Errors.**

Natural Science, vol. iii. pp. 275–281.

A reproduction is here given of a photograph of the left wing of the Berlin specimen of *Archæopteryx*. This shows seven primary quills, of which the middle one is straight, while the three anterior ones have a concavity backwards, and the three posterior have a concavity forwards. None of them are inclined towards the ulna, and it is thence concluded that none were attached to the ulna as is suggested by Steinman and Doderlein's figure. It is considered to be absurd to suppose that they were attached to any of the three slender visible digits, and that they must have been attached to the fourth and fifth digits now supposed hidden in the slab, but which are present in the London

specimen as figured by Owen. The three visible digits are said to have two, three, and four phalanges respectively, and are therefore the homologues of the digits i., ii., iii. of the normal pentadactyle sauropsidan fore-limb. It being assumed now that the wing of an ordinary bird is "essentially like" this, it is concluded that the large wing fingers of the former represent digits iv. and v. and not the digits ii. and iii. as ordinarily stated, but for which statement the author is not aware of any evidence whatever, and consequently he regards it as a mischievous error. The ala-spuria he considers to correspond to one or more of the free fingers of *Archæopteryx*. If these homologies are correct, the objection on the score of wing-structure against the derivation of birds from pterodactyls is done away with.

***623. Lydekker, R.—On some Bird-bones from the Miocene of Grive St. Alban, Department of Isère, France.**

Proc. Zool. Soc., 1893, part iii. pp. 517–522, pl. xli.

The remains here treated of are described as:—

*Strix sanctæ-albani**, spec. nov., represented by distal portions of the right tibia, and the proximal and distal halves of the left tarso-metatarsus, which are of the same size as the corresponding bones in *S. flammea*.

*Phasianus altus**, Milne-Edwards, represented by the proximal part of the left tarso-metatarsus, the distant end of the left humerus, the entire left ulna, and the complete left metatarsus.

*Palæortyx Edwardsi**, Depéret, represented by a right humerus, and a right tarso-metatarsus.

*P. maxima**, spec. nov., represented by a right coracoid.

*P. grivensis**, spec. nov., represented by a right humerus.

*Totanus Majori**, spec. nov., represented by a left humerus.

***624. Newton, Sir E., and Gadow, Hans.—On additional Bones of the Dodo and other Extinct Birds of the Mauritius, obtained by Mr. Théodore Sauzier.**

Trans. Zool. Soc., vol. xiii. pp. 281–302, plates xxxiii.–xxxvii.

The bones here described have been obtained from the marsh called "Marc aux Songes," whence almost all the previously obtained semi-fossil Dodo bones have been derived. They belong to:—

*Lophopsittacus mauritianus**, of which the anterior portion of the sternum, femur, and metatarsus have not been found before, and the lower mandible now described is larger than any previously known.

*Astur Alphonsi**, spec. nov., of which a pair of tibiæ, a pair of metatarsals, and the metacarpals of the left side are found.

*Strix sauzieri**, spec. nov., represented by humerus, tibia, and metatarsus.

*Plotus nanus**, spec. nov., represented by humerus, tibia, and pelvis with sacrum.

Podicepes, sp. inc., right ulna only.

*Butorides mauritianus**, spec. nov., represented by a pair of ulnæ, one radius, four metatarsi, and one coracoid.

*Sarcidiornis mauritianus**, spec. nov., represented by one specimen of left metacarpal bones.

*Anas Theodori**, spec. nov., represented by a fragment of a sternum, a pair of coracoids, eight humeri, and a pair of metatarsi.

*Fulica Newtoni**, of which the femur, sternum, humerus, and four cervical vertebræ are new.

*Aphanapteryx Broecki**, of which the pelvis with sacrum, femora, humeri, sternum (1 ex.), third cervical vertebra, and one nearly complete premaxilla are new.

Trocaza Meyeri, represented by four fractured breast-bones and three tarso-metatarsal bones.

Funingus, sp. inc., represented by an incomplete sternum.

Much new information is also to hand on the Dodo, the remains obtained being figured on two plates, which include "the first correctly restored and properly mounted skeleton," which will be placed in the Mauritius Museum at Port Louis. The following parts are now for the first time made known: the median distal portion of the furcula, which shows no "apophyse médiane" or hypocleidium, though this may be an individual variation; metacarpal bones of the right and left side and the first phalanx of the second finger; the distal third of the pubic bones; phalanges of the toes; and the atlas, or first cervical vertebra. It has been possible also to determine the number of vertebræ and ribs which belong to the various regions of the skeletal axis, though as no series can be affirmed to belong to a single individual the determination rests on circumstantial evidence. It had 13 (not 12) cervical vertebræ, 2 short ribs, 4 (not 5) sternal ribs, the last being carried by the first pelvic vertebra.

*625. Forbes, H. O.—The Moas of New Zealand.

Natural Science, vol. ii. pp. 374–380.

This is a discussion of a paper by J. W. Hutton on the Transactions of the New Zealand Institute. The author objects to the proposed classification by means of the ratio of length to girth of the long bones, and the proportions of the skulls, chiefly because of the uncertainty attaching to the combination of the long bones with the skulls, in order together to form the types of genera and species. He prefers to lay more stress on the forms and outlines of the bones. He also maintains his

opinion of the newer Pliocene or even the Pleistocene age of the oldest remains. He considers it also certain that the Maories and the Moas were inhabiting the island together, as the eggs are found associated in a cave with bones which have been carved by the Maories. As to the absence of traditions about them, he points out that the natives certainly fed on a certain black swan, and yet there are no traditions about it; he believes, indeed, that Moas were very probably still living when Captain Cook first visited the islands.

***626. Forbes, H. O.**—*Aphanapteryx.*

Bull. British Ornithologists' Club, No. ix. pp. l., li.

The author, on a comparison with the type of *Aphanapteryx* of the remains obtained by him in the Chatham Islands, New Zealand, which he described under the new generic name of *Diaphorapteryx* (*l.c.* iv. p. xxi.), reinstates them in this genus; there being no sufficient evidence of distinctness.

***627. Forbes, H. O.**—*Palæocasuarinus.*

Bull. British Ornithologists' Club, No. ix. p. li.

The author describes a new genus of *Dinornithidæ* upon tibiæ, obtained in New Zealand.

Palæocasuarinus, gen. nov.—The tibia differs from that of *Dinornis* (in its widest sense) in being straighter and less twisted on itself, so that the position of the ridge forming the inner wall of the groove for the tendons of the extensor muscles runs along the inner side of the bone, as in *Casuarinus*. As in the latter genus also, it takes a marked bend inwards and backwards before joining the epicnemial crest, while a line joining the centre point between the distal condyles and the epicnemial ridge leaves a considerable space between it and the wall of the groove.

Two species are described—*P. Haasti*, spec. nov., stouter and larger; and *P. velox*, spec. nov., more slender and smaller.

***628. Marsh, O. C.—Restorations of** *Anchisaurus, Ceratosaurus,* **and** *Claosaurus.*

Geol. Mag., Dec. 3, vol. x. pp. 150–157, plates vi.–vii.

Anchisaurus is allied to *Thecodontosaurus*. It has a small head and bird-like neck, ribs very slender, tail slender and flexible, and probably held above the ground. The animal, having much shorter fore than hind limbs, probably walked bipedally, and though its hind feet had four toes, only three might have made an impression on a firm beach, so that these may be the animals which have left the bird-like tracks on the Connecticut Triassic sandstones, in which the remains of their skeletons have been found. It was 6 ft. long.

Ceratosaurus was a bipedal carnivorous dinosaur, from the Upper Jurassic of Colorado. Its jaws resemble those of *Megalosaurus*, the cervical vertebra were episthocælous, but the dorsal and lumbar were biconcave. The pelvic bones are co-ossified; the ilia and ischia are expanded at the ends; the metatarsals are anchylosed; there were three toes in the hind foot and four in the small fore foot. The nasals show horn-cores, and hence the specific name *C. nasicornis*. The beast when standing 12 ft. high was 22 ft. long.

Claosaurus, from the Laramie of Wyoming. Bipedal, three toes on each foot, hind feet massive, hoofed. It had a remarkably long and blunt-ended muzzle, with a large lateral cavity in the upper jaw. All was covered with horn in life, and there were teeth only on the maxillary and dental bones. The cervical and dorsal vertebræ opisthocælian, and no true lumbars; all the caudals after the first have two long chevrons. Neural spines, from the mid-dorsal to the mid-caudal region, provided with long ossified tendons as in *Iguanodon*. The manus was long, with ungulate phalanges. When standing 15 ft. high the beast was 30 ft. in length.

***629. Lydekker, R. — Some recent Restorations of Dinosaurs.**

Nature, vol. xlviii. pp. 302–304.

Calls attention to recent discoveries by Prof. Marsh, and gives reduced figures of the restored skeletons of *Brontosaurus*, *Ceratosaurus*, *Hypsirophus* (= *Stegosaurus*), *Agathaumas* (= *Triceratops*), and *Iguanodon*.

Dr. Marsh on p. 437 complains of the character of this article.

***630. Boulenger, G. A. — On some newly-described Jurassic and Cretaceous Lizards and Rhynchocephalians.**

Ann. and Mag. Nat. Hist., 6, vol. xi. pp. 204–210.

First an answer is given to Dr. Barus' criticisms on the author's paper on *Heloderma* [No. **627**, 1891]; next an account with criticisms is given of a paper by Kramberger, on some Cretaceous lizards from Dalmatia; thirdly attention is drawn to the work of Dr. Lortet on the Jurassic reptiles of the Rhone Basin; and lastly the author modifies his classification of *Rhynchocephalia* [No. **316**, 1891], by the transference of the *Champso-sauridæ* to the sub-order *Proterosauria*.

***631. Seeley, H. G. — Researches on the Structure, Organization, and Classification of the Fossil Reptilia. Part viii.: On further evidences of *Deuterosaurus* and *Rhopalodon* from the Permian Rocks of Russia.**

Proc. Roy. Soc., vol. liv. pp. 168, 169 (abstract).

Deuterosaurus, *Rhopalodon*, and *Dinosaurus* have the Theriodont type of dentition. The palate of *Deuterosaurus* is of Plesiosaurian type. The back of the skull is a vertical plate, and the brain cavity rises in a long tubular form to the parietal foramen. The quadrate bones descend below the foramen magnum, in a way comparable with those of *Plesiosaurus*. There is only one [pair of] molar teeth.

The skull of *Rhopalodon* has a general resemblance to that of *Ptychognathus*. The orbit has sclerotic bones. There are 8 [pairs of] molar teeth, finely serrated posteriorly. There are 19–26 rib-bearing presacral vertebræ. The sacral vertebræ are deeply cupped; the ilium is of *Phocosaurus* type; the pubis and ischium are united as in Dicynodonts; the scapular arch consists of scapula, coracoid, and precoracoid. The bones of the fore-limb are relatively short; the hind-limb resembles that of *Pareiasaurus* proximally and of *Saurodesmus* distally. The tibia resembles that of *Pareiasaurus*, but is more slender.

These types are regarded as constituting a distinct group named *Deuterosauria*, in many respects intermediate between *Placodonta* and *Theriodontia*, but in skull structure approaching also to *Nothosaurus* and *Plesiosaurus*.

632. Hutton, F. W. — A new Plesiosaur from the Waipara River, New Zealand.

Proc. Geol. Soc., Session 1892–3, p. 151.

The species is called *Cimoliosaurus caudatus*, but is not described in this abstract.

***633. Newton, R. B.—On the Discovery of a Secondary Reptile in Madagascar, *Steneosaurus Baroni* (n. sp.), with a reference to some Post-Tertiary Vertebrate Remains from the same country, recently acquired by the British Museum (Natural History).**

Geol. Mag., Dec. 3, vol. x. pp. 193–198, plate ix.

The specimens described are a rostrum, a mandible, and a scute, from the north-western part of the island. In the presence of a long snout, furnished with numerous bicarinated teeth, obliquely set; a long narrow mandibular symphysis; extensive temporal fossæ; an oblique, quadrangular, supra-occipital, and a transversely elliptical foramen magnum, are recognized the characters of the genus *Steneosaurus*. The very narrow and cylindrical rostrum, with a marked undulation, indicate its specific distinctness; hence it is named after its discoverer, the Rev. S. Baron, *S. Baroni**, spec. nov. Some bones of *Crocodilus robustus*, *Æpyornis maximus*, and *Hippopotamus Lemerlei* from post-Tertiary deposits in a region of

extinct volcanoes in the centre of the island, and some of *Testudo Grandidieri*, from a cave near the south, are also recorded.

634. Traquair, R. H.—Notes on the Devonian Fishes of Campbelltown and Scaumenac Bay, in Canada. No. 2.

Geol. Mag., Dec. 3, vol. x. pp. 145–149 and 262–269. For No. **1** *see* No. **696**, 1890.

Notes on *Protodus Jexi*, A. S. W.; *Doliodus problematicus* (A. S. W.). *Doliodus*, gen. nov., is instituted for this tooth, because instead of the thick, solid base of *Diplodus* we have here a broad, thin plate, convex anteriorly and above, concave posteriorly and below, to the upper margin of which the crown is attached. *Cheiracanthus costellatus*, spec. nov., Whit. Spines more slender and less conical than those of *H. gracilis*, and without posterior denticles; *Cephalaspis campbelltownensis*, Whit.; *C. Jexi*, spec. nov., with a rounded snout, formerly referred to *C. campbelltownensis*, on the supposition that that species had a rounded snout, whereas it is now found to be pointed, which also makes the author's name of *C. Whiteavesi*, given on account of the pointed snout [*see* No. **696**, 1890], fall as a synonym; *Phlytænaspis acadica*, Whit., with a restoration of the ventral carapace.

635. Traquair, R. H.—Notes on the Devonian Fauna of Campbelltown and Scaumenac Bay, in Canada. No. 3: Fishes from the Upper Devonian of Dalhousie, Scaumenac Bay.

Geol. Mag., Dec. 3, vol. x. pp. .

The author gives the new generic name of *Scaumenacia*, gen. nov., to the fish described by Whiteaves as *Phaneropleuron curtum*, on the ground that as far as he knows the latter genus has only one dorsal fin, whereas this particular fish has two. He includes the genus with *Phaneropleuron*, *Dipterus*, and *Ctenodus* in his family Ctenodontidæ, characterized by numerous dermal cranial roof-plates and a Ctenodont dentition. Some notes are added on specimens of *Coccosteus canadensis*, A. S. W., *Glyptolepis quebecensis*, Whit., and *Eusthenopteron Foordi*, Whit., which has a small pineal foramen between the frontal bones, and the palatal dentition is similar to that of *Tristichopterus*.

636. Traquair, R. H.—Notes on the Devonian Fishes of Campbelltown and Scaumenac Bay, Canada. Parts I. and II.

Proc. Roy. Phys. Soc. Edinburgh, vol. xii. pp. 111–118, 118–125.

These two papers are the same as those in the Geol. Mag. above No. **634**, **635**.

***637. Claypole, E. W.—The Upper Devonian Fishes of Ohio.**

Geol. Mag., Dec. 3, vol. x. pp. 443–448.

The fishes here described are from the black Cleveland shale, which forms part of a series intermediate between undoubted Carboniferous and Devonian shales. They are remains of species of *Cladodus* showing impressions of the body, and are more fully described in the "American Geologist" for May, 1893. It appears that the head of some of these fishes was expanded like that of the bonnet shark. There was also a horizontal flap just in front of the caudal fin, but without shagreen, and quite soft. No spines are present, so that the spines called *Ctenacanthus* cannot belong to it, as has been supposed. The shagreen on the dorsal surface is of the ordinary kind, but there is none on the ventral surface, where the rhomboidal scales take its place. There is no trace of a median axis in the pectoral fins. These fishes occur in the same beds with *Coccosteus*, and thus date from earlier times than the true Carboniferous.

***638. Woodward, A. S.—Some Extinct Sharks and Ganoid Fishes.**

Natural Science, vol. ii. pp. 435–438.

Draws attention to a new instalment of A. Fritsch's "Fauna der Gaskohle," in which are given restorations of *Acanthodes*, which is a shark provided with membrane bones; and of *Trissolepis*, a Palæoniscoid, representing ancestral sturgeons, which had cycloid scales on most of its body, but ganoid scales on the upper lobe of its tail.

***639. Woodward, A. S.—Further Notes on Fossil Fishes from the Karoo Formation of South Africa.**

Ann. and Mag. Nat. Hist., 6, vol. xii. pp. 393–398, plate xvii.

*Dictyopyge ? Draperi**, spec. nov. — Fins small, with many articulated rays; scales as deep as broad, reduced on the caudal pedicle.

*Atherstonia minor**, spec. nov.—Smaller than *A. robusta*, and with a more robust trunk.

*A. Seeleyi**, spec. nov., scales with oblique ridges converging to the postero-inferior angle.

An undetermined Palæoniscoid fish is also figured.

***640. Woodward, A. S. W.—Palæichthyological Notes.**

Ann. and Mag. Nat. Hist., 6, vol. xii. pp. 281–288, plate x.

III. On *Gyrolepis dubius*, spec. nov., from the Rhætic formation of Scania.—Fragments showing some scales and part of a dorsal fin, thought to belong to *Gyrolepis*, and, if so, differing in detail from the known species.

IV. On a new Palæoniscoid fish from Siberia. Describes some specimens brought by Herr Martin from the province of Yenissei as the representative of a new genus.

Gaxolepis, gen. nov.—Trunk elegantly fusiform; mandibular suspensorium oblique; well-spaced conical laniaries; external head bones and opercular bones with striations, rugæ, and dots of ganoine; fins small, without fulcra, rays delicate, distally bifurcated; dorsal and anal fins triangular, the former situated opposite the space between the pelvic and anal fins; upper caudal lobe slender, and the caudal fin forked; scales large and thick, covered with ganoine, and ornamented with transverse ridges, usually serrated at the hinder border; lateral line conspicuous; scales with fine parallel, horizontal, or oblique ridges. The species is called *G. gracilis**, spec. nov.

***641. Woodward, A. S.—Some Cretaceous Pycnodont Fishes.**

Geol. Mag., Dec. 3, vol. x. pp. 434–436, plate xvi.

1. On *Arthrodon*.—This genus exhibits no successional teeth, and thus belongs to the Pycnodonts; but it retains its initial irregularity of teeth. Its roughened symphysial facette is also twice as deep as usual. The following are the recognized species:—

A. Douvillei, Sauvage, Portlandian, Boulogne; *A. boloniensis*, Sauvage, Kimmeridgian, Boulogne; *A. Wittei* (Fricke), Kim., Hanover; *A. profusidens* (Cornuel), Neocomian, Haute Marne; *A. intermedius* and *A. crassus*, British [*see* No. **372**].

*A. tenuis**, spec. nov.—Splenial bone elongated, with large, closely arranged teeth, mostly smooth and nearly circular, disposed in about four irregular series, of which that next to the innermost is the largest. Lower Senonian, Belgium.

***642. Woodward, A. S. — On the Dentition of a Gigantic Extinct Species of *Myliobates* from the Lower Tertiary Formation of Egypt.**

Proc. Zool. Soc., 1893, part iv. pp. 558, 559, plate xlviii.

The specimen described comes from the Mokattam Hills, and is the largest known of the genus. It consists of the upper and lower jaws, the latter with seventeen, the former with six median teeth preserved. It is called *M. Pentoni**, spec. nov.

INVERTEBRATE PALÆONTOLOGY.

***643. (BV).[1]—Tertiary and Triassic Gasteropoda of the Tyrol.**

Nature, vol. xlviii. pp. 567, 568.

Gives an account of two recent papers on the subject, one by J. Dreqet and the other by E. Kittl.

***644. Newton, R. B.—On the occurrence of *Chonetes Pratti*, Davidson, in the Carboniferous Rocks of Western Australia.**

Rep. Brit. Assoc. for 1892, pp. 725, 726.

Published in 1892 in the Geological Magazine [*see* No. **506**, 1892].

***645. Jones, T. R.—On some Fossil Ostracoda from S.W. Wyoming and from Utah, U.S.A.**

Geol. Mag., Dec. 3, vol. x. pp. 385–391, plate xv.

The shells here described are from some shales of the Montana formation just below the Laramie in Utah; also from some silicified Upper Cretaceous Limestone of the Bear River formation, Wyoming:—

*Cypris purbeckensis**, Forbes, Wyoming. *Cypridea tuberculata* (Sow.) var. *wyomingensis**, nov., Wyoming. *Potamocypris unisulcata**, Jones, Utah.

*Candona subreniformis**, spec. nov.—Fuller in the posterior third than *C. Kingsleei*, B. and R. Utah.

*C. subovata**, spec. nov.—Longer and narrower than *C. incongruens*, also the edge view is too thick, and the flattened margin is absent. Utah.

*Metacypris subcordata**, spec. nov.—Transverse constriction more marked, dorsal region more depressed, ventral region more deeply excavated than in *M. cordata*, B. and R. Wyoming.

*M. consobrina**, spec. nov.—Shorter than *M. Bradyi*, longer than *M. Forbesii*. Wyoming.

*M. cuneiformis**, spec. nov.—Like an oblong wedge, no surface markings. Wyoming.

*M. simplex**, spec. nov.—Less truly oblong, more uniformly convex than the last. Wyoming.

*Cythere monticula**, spec. nov.—Valves broad in front, narrow and subtruncate behind, a sharp ridge on the ventral region, a central tubercle, and a swelling in front and behind. Wyoming.

*Cytheridea truncata**, spec. nov.—Subtrigonal, truncate in front, oblique behind, a shallow pitting on the surface. Wyoming.

*C. tenuis**, spec. nov.—Subtriangular, ovate, ends rounded, hinder end narrow, ventral border straight, surface slightly tuberculate. Wyoming.

*Cytherideis æqualis**, spec. nov.—Narrow, curved, ends rounded, edge view lanceolate. Wyoming.

*C. impressa**, spec. nov.—With a broad and shallow constriction in the middle of the ventral region. Wyoming.

***646. Jones, T. R., and Woodward, H.—The Fossil Phyllopoda of the Palæozoic Rocks.**

Geol. Mag., Dec. 3, vol. x. pp. 529–534. (Read at Brit. Assoc.)

Describes *Estheria striata* (Münster) var. *Muensteriana*, nov. Permian, Hesse.

E. Reinachii, spec. nov.—Differs in shape and proportions from *E. striata*. Upper Lebach Beds, Wetterau.

E. Geinitzii, spec. nov.—Subquadrate, anterior and ventral sides more fully rounded, back straight, umbo in front; same locality. Also var. *Grebeana*, nov., more subtriangular.

Some records are given of Phyllopods recently described abroad; and the name *Peltocaris anatina*, Salter, is changed to *P. Marrii*, nom. nov., the former specific name being transferred to the *Aptychopsis* recorded as *A. cordiformis*, spec. nov., in No. **308**, 1892, which is now called *A. anatina*.

***647. Hinde, G. J.—On *Palæosaccus Dawsoni*, a new Genus and Species of Hexactinellid Sponge from the Quebec Group (Ordovician) at Little Metis, Quebec, Canada.**

Geol. Mag., Dec. 3, vol. x. pp. 56–59, plate iv.

The specimen is flattened in black carbonaceous shales, and is now composed of pyrites.

Palæosaccus, gen. nov.—Cylindrical or sac-like, with thin walls of rhombic meshes, whose strands consist of fascicles of slender rods. The interspaces are either open, or covered with a thin layer of irregularly formed rods and cruciform spicules. Some long anchoring spicules in the same beds may perhaps belong to this. The specimen is named *P. Dawsoni**, spec. nov.

***648. Jukes-Browne, A. J.—Foraminiferal Limestone from the Grenadine Islands, West Indies.**

Geol. Mag., Dec. 3, vol. x. pp. 270–272.

Several samples sent by G. F. Franks, from Canouan, have been examined. They are limestones composed in one case of Globigerinæ, in another of *Amphisteginæ* and *Nummulites*, and in a third of all three. Such limestones are not known nearer than Barbadoes, 120 miles, and Trinidad, 170 miles away; but it is most likely an extension of the latter.

***649. Hinde, G. J.—Note on a Radiolarian Rock from Fanny Bay, Port Darwin, Australia.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 221–226, plate v.

This rock is soft, white, and chalk-like, but it contains

84·20 of silica and 10·70 of alumina. The Radiolaria are new species, and the genera range from the Palæozoic upwards.

Sub-order PRUNOIDEA.

*Cenellepsis**, sp.

Sub-order DISCOIDEA.

Astrophacus, spp. *a** and *b**.

*Lithocyclia exilis**, spec. nov.—Test circular, with six or eight rings surrounding the medullary sphere.

*Amphibrachium crassum**, spec. nov.—Test elongate, with the ends slightly inflated and rounded.

*A. truncatum**, spec. nov.—Test elongate, biclavate, the arms either truncate or slightly bifurcate at the ends.

*A. fragile**, spec. nov.—Test subclavate, with a slight inflation in the centre, pores arranged in longitudinal series.

A. sp.*—Test elongate, biclavate, with a subcircular central disc, arms subcircular, divided by five or six curved partitions.

*Spongodiscus expansus**, spec. nov.—Test subcircular in outline, with an apparently minutely reticulate or porous structure throughout.

Sp. sp.*—With traces of a medullary test, and sp.* with a border of small triangular spines.

*Spongolena symmetrica**, spec. nov. — Test in form like a dumb-bell. The ends of the arms inflated or rounded, centre cylindrical, structure minutely reticulate.

Sub-order CYRTOIDEA.

*Dictyomitra australis**, spec. nov.—Test conical, with 8–10 horizontal partitions.

*D. triangularis**, spec. nov.—Conical, with seven or eight horizontal partitions.

*Lithocampe fusiforme**, spec. nov.—Test elongate, fusiform, four horizontal partitions, terminal aperture small, without a perforate plate.

*Stichocapsa pinguis**, spec. nov.—Test subcylindrical, with five partitions, the first two segments small, traces of a perforate plate.

*S. chrysalis**, spec. nov. — Test spindle-shaped, with four segments, the last largest, with a perforate plate.

It appears that the rock lies on a soft, ochre-like clay, and is capped by a ferruginous conglomerate. It is the same as that called "magnetite" in Tenison Woods' Report on the district.

650. Judd, J. W.

Proc. Geol. Soc., vol. xlix. p. 146.

Exhibited specimens of *Arthrophycus* from the interior of the Gold Coast.

MINERALOGY.

651. Dick, A.—On Geikielite, a new mineral from Ceylon.

Min. Mag., vol. x. pp. 145–147. [*See* No. **517**, 1892.]

Details are given of the method of analysis employed. The composition is—

Titanic acid	67·74
Magnesia	28·73
Protoxide of iron	3·81
	100·28

It is therefore considered to be a slightly impure titarate of magnesia. Spec. grav., 3·98; hardness, 6; lustre, metallic-adamantine; one brilliant cleavage and an imperfect one nearly at right angles; brittle; bluish or brownish black, thin fragments showing a peculiar purplish red light; refractive index apparently high; double refraction very strong, negative; slowly decomposes in hot H Cl; infusible alone. Associated with this are yellow, more transparent fragments, yielding 99·2 titanic acid and a positive uniaxial figure, and hence considered to be rutile.

*652. Fletcher, L.—The occurrence of Native Zirconia (Baddeleyite).

Nature, vol. xlvii. pp. 283, 284.

Dr. Hussak has found a mineral in Brazil which, on analysis by Professor Brömstrand, has turned out to be zirconia. At the same time it is reported that the Brazilian mineral has a spec. grav. of 5·006, whereas Baddeleyite has a spec. grav. of 6·025. It is therefore suggested that there are really two minerals in association, as there are also in Ceylon, and that the mineralogical characters have been determined from the ore (zirconia) and the chemical characters from the other, which is a tantalo-niobate of some member of the yttrium-cerium group, as originally stated by Dr. Hussak.

*653. Fletcher, L.—On Baddeleyite (Native Zirconia), a new mineral from Rakwana, Ceylon.

Min. Mag., vol. x. pp. 148–160.

A single specimen has been submitted to Mr. Baddeley as Geikielite. It shows only one well-developed zone, consisting of two large parallel pinacoid faces *a*, *ā*, a narrow pinacoid face *b*, perpendicular to the former, and three prism faces *m*, $\bar{m}$, $\bar{m}'$; there are also two other faces at the end, *d* and *d*, forming a re-entrant angle, whose edge is parallel to the face *ā*. This

is considered, for reasons given, to indicate twinning about the face $\bar{a}$. The following elements have been determined :—

System.—Monosymmetric.

Elements.—$a : b : c = 0{\cdot}4768 : 1 : 1{\cdot}0475$
$ac = 180^\circ - \beta = 81^\circ 20'$

Parametral angles.—$100 - 110 = 44^\circ$; $001 - 101 = 47^\circ 23'$;
$001 - 011 = 46^\circ$

Forms.—a [100]; b [010] also cleavage; m [110]; d [011].
Fracture faces n, $\bar{1}\bar{1}1$; r, $\bar{1}02$; twin face a.

Thin flakes are yellow, biaxial, apparent axial angle about 70°–75°, dispersion probably inclined and plane of optic axis parallel to b, extinction on b 13° from the vertical edge $a\ m$; one optic axis nearly perpendicular to r; double refraction strong, negative; pleochroism yellow to brown.

Prolonged fusion with potassium bisulphate or long digestion of the powder with strong sulphuric acid, brings about solution. The yellow colour is due to iron. Details of the chemical analysis are given, by which it is shown to be zirconia, which is confirmed by comparing the long, flat, colourless crystals produced by the evaporation of the hydrochloric acid solution of the ammonia precipitate with those formed in the same way from zirconia.

It is noted in an appendix that the mineral found in an augitic rock at S. Paulo, Brazil, whose crystallographic elements had been determined by Dr. Hussak, and which had been called by him Brazilite, now proving to be zirconia, instead of a tantalo-niobate of yttrium [*see* No. **652**], he withdraws the name Brazilite in favour of that given to the Ceylon mineral Baddeleyite.

*654. Prior, G. T.—Fergusonite from Ceylon.

Min. Mag., vol. x. pp. 234–238.

Mr. Fletcher's suggestion that two minerals from Brazil had been confounded under the term Brazilite, of which one was Baddeleyite, is here shown to be probable, because there is associated with the true Baddeleyite of Ceylon a mineral which has the specific gravity and chemical composition of the second, as described by Dr. Hussak.

In three specimens of the Ceylon mineral the spec. grav. is 5·49, 5·023, and 4·54.

Analysis of the second gives—

Nb_2O_5	44·65
Ta_2O_5	4·98
UO_3 } UO_2 }	5·11
YO_3	24·67
Er_2O_3	13·24
CaO	2·02
Fe_2O_3	0·51
H_2O	4·58
	99·76

This corresponds to Fergusonite, with which the minera otherwise fairly agrees; but as there are several hydrates of Fergusonite, whose specific gravity falls with the increase of hydration, it is supposed that these specimens may represent the mono-, di-, and tri-hydrates respectively. They are all isotropic, but become anisotropic on heating to redness. The only one that glows at that temperature is the first or heaviest, so that this phenomenon may be connected with the degree of hydration.

655. Goyder, G. A.—Stibiotantalite, a new mineral.

Journ. Chem. Soc., vol. lxiii. pp. 1076–1079.

This mineral is found among the ore at Green Bushes, Western Australia. The methods of analysis are detailed, the results for two samples being—

Ta_2O_5	51·13	51·95
Nb_2O_5	7·56	4·49
Sb_2O_3	40·23	38·04
Bi_2O_3	0·82	0·79
NiO	0·08	tr.
Fe_2O_3	tr.	0·39
CuO	—	0·30
SiO_2	—	3·14
H_2O at red heat	0·08	0·16
	99·90	99·71
Spec. grav.	7·37	6·60

The first is the purer example. Crystallization perhaps rhombic. H. 5–5½. Lustre adamantine. Colour pale reddish-yellow. Streak nearly white. Opaque to translucent. Fracture subconchoidal to granular.

656. Mackenzie, C.—Notes on Ceyolite.

Stirling Nat. Hist. and Arch. Soc. Trans. 1892, pp. 102–104.

Historical notes on its discovery and the method of working.

***657. Lewis, W. J.—Note on a Crystal of Tourmaline.**

Min. Mag., vol. x. p. 142.

A crystal from Ceylon shows the very rare faces $z = (\bar{1}.\ 2.\ 2)$, on the existence of which some doubt has been thrown. The faces are triangular and give a broken reflection; the mean angle oz is $27°35'$.

***658. Trechmann, C. O.—Binnite from Lunfeld in the Binnenthal.**

Min. Mag., vol. x. pp. 220–228.

This rare mineral, believed to conform to the formula $Cu_6 As_4 S_9$, shows hemihedral development in some cases, and in others not. The author has examined two very perfect crystals from cavities in the white dolomite, and their hemihedral nature is well characterized by the striations on the faces in the zone (100): K (111); by the corrosion of the K ($1\bar{1}1$) faces; and by the *almost* complete restriction of the (h k k), (h h l), and (h k l) forms to the positive octants. A table is given showing 53 forms, of which the following are for the first time observed:—

K (7. 5. 5), K (8. 5. 5), K (17. 10. 10), K (9. 5. 5), K (19. 10. 10), K (21. 10. 10), K (12. 5. 5), K (5. 2. 2), K (13. 5. 5), K (27. 10. 10), K (14. 5. 5), K (3. 1. 1), K (16. 5. 5), K (7. 2. 2), K (19. 5. 5), K (9. 2. 2), K (47. 10. 10), K (5. 1. 1), K (11. 2. 2), K (13. 2. 2), K (37. 5. 5), K (8. 1. 1), K (9. 1. 1), K (12. 1. 1), K (16. 1. 1), K (28. 1. 1), K (34. 1. 1), K (76. 1. 1), K (2. $\bar{1}$. 1), K (28. $\bar{1}$. 1), K (8. 8. 5), K (9. 4. 4), K (5. 5. 2), K (12. 12. 1), K (30. 30. 1.), K (8. $\bar{8}$. 5), K (2. $\bar{2}$. 1), K (5. $\bar{5}$. 2), K (3. $\bar{3}$. 1), K (13. $\bar{13}$. 1), K (23. 12. 11).

A number of these narrow faces belong to the class of vicinal planes, and others may be due to subsequent corrosion. It is noted as a remarkable circumstance that the angles between certain parts of the faces are the same, *e.g.* that between (1. 1. 1) and (1. $\bar{1}$. 1), and between (2. 1. 1) and (2. $\bar{1}$. $\bar{1}$), is $70^\circ 31' 44''$.

659. Miers, H. A.—Xanthoconite and Rittingerite, with remarks on the Red Silvers.

Min. Mag., vol. x. pp. 185–216.

The history of these two minerals is given, but on their re-examination the author finds that they are one and the same, having the percentage composition of proustite, but differing from it in physical and morphological characters — being isomorphous with fireblende. These results have been obtained by the examination of about 30 specimens of minerals referred to the former species, and of 10 referred to the latter. The crystallographic details of several of these are given, with a general description of the optic and chemical characters of the two groups. Thus the name rittingerite becomes a synonym, and the characters of xanthoconite are thus given.

System.—Monosymmetric.
Elements.—$a:b:c = 1{\cdot}9187 : 1 : 1{\cdot}10152$ $\beta = 88^\circ 47'$.
Forms.—p [1. 1. 1], q [5. 5. 1], d [5. 0. 1], m [1. 1. 0], P [$\bar{1}$. 1. 1], Q [$\bar{5}$. 5. 1], D [$\bar{5}$. 0. 1], c [001]. Twin plane c, common.

Cleavage distinct on C; brittle; H 2–3; spec. grav. 5·54; opticaxial plane perpendicular to the plane of symmetry; bire-

fringence strong, negative; apparent axial angle in air about 125°; $\rho > v$; acute bissectrix nearly normal to *c*. Composition, $Ag_3 As S_3$.

660. Ulrich, G. H. F.—On a Discovery of "Oriental Ruby" and "Margarite" in the province of Westland, New Zealand.

Min. Mag., vol. x. pp. 217–219.

In working the gold drift at Back Creek, near Rimù, a large boulder was observed of unusual weight and colour. On examination it is found to be composed of an irregular mixture of ruby and a green mineral which on analysis proves to have the composition of margarite or lime-mica; the mineral, however, breaks with a splintery fracture, has a hardness of 3½ and a spec. grav. of 3·025. Its colour is due to a small percentage of chromium-sesquioxide.

***661. Dumble, E. T.—On the occurrence of Grahamite, in Texas.**

Colliery Guardian, vol. lxv. p. 555.

Read to the American Institute of Mining Engineers. The material here referred to occurs in Eocene beds, in Webb county, at Webb Bluff (1), in a thin 3–6 in. seam, between argillaceous sandstone and greensand marl; it is largely mixed with gypsum and sulphur. A second example is in Fayette county, at O'Quin Creek (2), as small inclusions on a half-inch band of brown coal. The physical characters in both cases are those of Grahamite, and the analyses show the proper composition:—

	(1)	(2)
Carbon	78·65	76·19
Hydrogen	7·50	6·61
Nitrogen	0·15	0·39
Oxygen	5·08	5·15
Sulphur	5·42	7·45
Ash	2·90	4·21
Water	0·30	—
	100·00	100·00

PETROLOGY.

***662. Judd, J. W.—On a Meteorite which fell at Jafferabad, in India, on April 28, 1893.**

Nature, vol. xlix. pp. 32, 33.

A native report obtained by J. W. Evans is here translated. A specimen has also been obtained and examined by L. Fletcher,

who states that it weighs ¾ oz., and is undoubtedly a true meteorite with a very thick crust. The surface is very white, with metallic spangles. Spec. grav. 3·55.

663. Anon.—A large Meteorite.

Iron, vol. xli. p. 228.

Notes the receipt by Mr. J. R. Gregory of a meteorite from Youndegin, Western Australia. It is 4 ft. 2 in. long, 2 ft. 3 in. wide, and 1 ft. 8 in. high, and weighs 2044 lbs., and thus is the second largest now in Europe. It is not decayed, and is thought to have recently fallen.

664. Ulrich, G. H. F.—On a Meteoric Stone found at Makanwa, near Invercargill, New Zealand.

Proc. Roy. Soc., vol. lii. p. 504.

The specimen was found in 1879 in a bed of clay. It contains: nickel-iron, 1; oxides of nickel and iron, 10; troilite, 6; enstatite, 39; and olivine, 44 per cent. It is now in small fragments.

665. Ulrich, G. H. F.—On a Meteoric Stone found at Makanwa, near Invercargill, New Zealand.

Proc. Roy. Soc., vol. liii. pp. 54–64.

In this paper are given details of the microscopic structure and of the several minerals. The olivine is partly in well-defined chondrules, partly in grains and columnar bodies, and none is serpentinized; enstatite also occurs in chondrules, and porphyritically it shows undulose extinction. There is some isotropic glass, and some anisotropic material believed to be due to devitrification. The nickel-iron is unequally distributed, and is mostly in small specks. Troilite, as yellow, bronze-coloured, metallic specks, is small in quantity, but there is doubtless more, coated with ferric oxide. Magnetite is irregularly distributed, often as borders to the chondri of olivine. The spec. grav. is 3·31–3·54. Six figures of sections are then described.

666. Newton, H. A.—Lines of Structure in the Winnebagolo Meteorites, and in other Meteorites.

Nature, vol. xlviii. pp. 370, 371.

The polished surface shows several hundred bright metallic points, which in some aspects seem to run in lines.

667. Bonney, T. G.—Note on the Nufenenstock (Lepontine Alps).

Quart. Journ. Geol. Soc., vol. xlix. pp. 89–93.

The author describes the exposures met with in a traverse from the Nufenan pass over the Nufenenstock from north to south, and back again by a sloping path a little to the west. The succession over the Nufenenstock is as follows: gneiss, thin band of rauchwacke, black mica-schist, thin band of disthene schist and rauchwacke, black mica-schist, band of spotted Jurassic, thick mass of black mica-schist forming the summit and southern slopes of the Nufenenstock, thin band of disthene schist, rauchwacke. The other section along the slope is similar, except that there is a thin band of rauchwacke between the Jurassic and the black mica-schist of the summit. A figure of the sections is given, by which it is indicated that the bands are vertical, the rauchwacke and Jurassic being believed to be infolded amongst anticlines of the schists.

668. Bonney, T. G.—On some Schistose "Greenstones" and Allied Hornblendic Schists from the Pennine Alps, as illustrative of the effects of Pressure Metamorphism.

Quart. Journ. Geol. Soc., vol. xlix. pp. 94–103.

The author takes examples of rocks which from external appearances may be considered to have certainly been subjected to pressure, and describes their microscopic structure, so as to ascertain the characteristics of such altered rocks.

The first is from a lenticular mass of "greenstone" in the calc schists of the Mittaghorn, the micaceous bands of which, "indicative" the author presumes "of an original stratification, sweep round it like the lids round the ball of the eye." It contains a mineral resembling chlorite, but which may be a hydrous form of biotite; also epidote, actinolite, calcite, etc., and rather abundant grains of a water-clear mineral presenting resemblances to quartz and kyanite, but which is regarded as a felspar. "The constituents exhibit some orientation, and the rock would be accepted without hesitation as a crystalline schist, yet that it was formerly a basalt or dolerite can hardly be doubted." Its analysis by **A. A. Longsden** gives—

Silica	43·70
Alumina	23·44
Ferric oxide	3·14
Ferrous oxide	5·27
Lime	13·05
Magnesia	3·54
Soda	4·86
Water	2·40
Carbonic acid	2·92
	102·32

Two other examples, showing the same minerals in varying proportions, are then briefly discussed.

Four specimens of the larger masses of green schists also contain the same important constituents. In one the water-clear mineral shows polysynthetic twinning, and there is an "eye" of original hornblende. "The undulating lines of the actinolitic and other microliths can be traced right through the grains of the water-clear mineral." It is thought probable that these rocks are of igneous origin, and that pressure has been a most important, if not the main agent of change.

Four other miscellaneous examples, believed to be intrusive in calc-mica schists, show hornblende, biotite, etc., with opaque streaks in an irregular granular mass of water-clear mineral.

The author concludes that doleritic rocks may be converted into hornblende schists; new minerals, in the order hornblende, epidote, biotite, water-clear felspar, and quartz, being produced.

669. Bonney, T. G.—On a Secondary Development of Biotite and Hornblende in Crystalline Schists from the Binnenthal.

Quart. Journ. Geol. Soc., vol. xlix. pp. 104–113.

The first case described is that of a dark mica-schist above the village of Binn. The matrix is like a mass of matted fibres of a colourless mica; there are also garnets with streaks of opacite passing through them. But the most remarkable feature is a large crystal of biotite ·175 in. long by ·03 in. broad, which lies across several opacite streaks, and is invaded here and there by the matrix. This shows conclusively that the crystal has at least been reconstructed, and possibly entirely formed, after the production of the schistosity.

The second case is that of a schist from Hohsandhorn, the matrix of which resembles that of the garnet schists, but contains, instead of garnets, numerous comparatively large actinolite crystals from ½ in. to ¾ in. long and about $\frac{1}{16}$ in. thick. The streaks of opacite often exhibit sharp flexures, and these are continued right across the hornblende crystal, an incontrovertible proof that the latter has been formed subsequently to the foliation and contortion of the rock [fig. 30]. The mineral contains granules of quartz, and is here and there bordered by biotite, which also eats into it, and is therefore probably still later.

The author thinks these changes probably occurred in pre-Triassic times.

670. Bonney, T. G. — On some Quartz-Schists from the Alps.

Geol. Mag., Dec. 3, vol. x. pp. 204–210.

Describes some quartz-schists found in the valley of Saas-Fee. Some are flaggy with micaceous layers, some, as on the

Mittaghorn, *appear* to pass into gneiss; the foliation has been produced in pre-Mesozoic times and so original grains are left; in this they differ from ancient quartzites, even when, by pressure, these have become schistose. These quartz-schists, indeed, give no proof that their structure was caused by pressure.

FIG. 30.—Contorted streaks of opacite in secondary hornblende crystal.

*671. Emmons, H.—The Petrography of the Island of Capraja.

Quart. Journ. Geol. Soc., vol. xlix. pp. 129–144.

This island consists of a number of andesitic outflows resting on andesitic breccias and agglomerates. At the southern end the phases of volcanic activity are indicated by—

a. Breccias, which in Cela il Moreto seem to rest unconformably on the northern breccias.
b. One or two lava streams of anamesite.
c. Highly scoriaceous ejectamenta.
d. More than 40 thin lava streams, each separated from the others by a few inches of scoriæ, similar to those of phase *c*.
e. A mass of anamesite, which has forced its way up, cutting through the cone, and sending out apophyses into the lava streams.

It is thought that the main vent lay to the westward of the island. The andesite contains porphyritic felspar and black mica and olive-green pyroxene; the dykes are more compact in

texture; the anamesite has two varieties—the first a grey, fairly compact rock, the second very hard and compact.

Mineralogically the andesites may be divided into augite-mica-, hornblende bearing augite-mica-, olivine bearing augite-mica-, and hypersthene bearing augite-mica-andesites, though these pass into each other. The minerals are plagioclase mica (with hexagonally arranged cracks), augite, hypersthene, hornblende, olivine, tridymite, apatite, magnetite, and epidote (in one case). The ground-mass plays an important part, and contains glass, idiomorphic lath-shaped felspar, augite, magnetite, mica, and hornblende. There is no evidence of any "intratelluric period" of formation, but magnetite and apatite were formed before the rest. Olivine and hypersthene were formed earlier than the ferro-magnesian constituents, but the hornblende is never of two generations in the same rock.

The anamesite is holocrystalline, the minerals having formed in the following order—magnetite, olivine (porphyritic), augite, mica, felspar, and nepheline. Analyses are given of several samples of both varieties of rock.

***672. Johnston-Lavis, H. J. — Notes on Pipernoid Structure of Igneous Rocks.**

Natural Science, vol. iii. pp. 218–221.

The building stone called piperno, which occurs near Naples, is a curious rock, as it "may be called a rather basic trachyte," but it contains "flackers," or flattened cakes of an originally pasty material of the same chemical composition as the rest of the rock, which is spongy and grey, and "exhibits all the characters of a tuff." It is thought that, in the eruption by which it was produced, the upper portion of the large pipe contained more aquiferous material than the lower, so that the former "was soon reduced to a solid dust by vesiculation," while the latter "was only separated into cakes," which were then squeezed flat and pulled out in proportion to the inclination at which they lay where fallen. This supposition also accounts for the distribution, the heavier cakes falling near the vent, the lighter, vesicular ones at a greater distance, and the fine dust reaching still further away than any of the "flackers." It is believed that this explanation will answer for rocks of the same type in widely separated localities.

***673. Johnston-Lavis, H. J.—The Ejected Blocks of Monte Somma.**

Trans. Edinburgh Geol. Soc., vol. vi. pp. 314–351, plates xiii., xiv.

The blocks ejected are classed as essential, accessory, and accidental, the first belonging to the eruption itself, the second

to earlier products of the same vent, and the last to the non-volcanic rocks through which both have forced their way. These were principally ejected in the eruption described as "Period iv. phase vi.," and many were re-ejected in "Period i. phase vii." The present paper deals only with the stratified limestones.

The limestones of Sorrento are dolomitic, and many analyses of them are quoted in order to show that there is very little original silica in them. Hence it is clear that the silica, alumina, iron, and fluorine now found in them must have been introduced from without, it is believed by sublimation, *i.e.* by the reactions caused by vapours. Detailed descriptions follow of the microscopic appearances of 24 of these rocks, showing the gradual increase of metamorphism, ten being illustrated by the plates. From a study of these it appears that the carbonaceous matter first changes to graphite at the period of the marmorosis, and then peridote makes its appearance. The alteration takes place without fusion of the rock, as the details of stratification are not obliterated, and the nature of the alteration is affected by the composition of the various layers. The order of development of new minerals is stated to be—

1. Peridote, Periclase, Heimite.
2. Spinel, Mica, Fluorite, Galena, Pyrites, Wollastonite.
3. Garnet, Idocrase, Nepheline, Sodalite, Felspar.
4. Secondary Calcite.

There is on the one hand an introduction of new material from the lava, and on the other a loss of constituents from the limestone.

674. Cooke, J. H.—On the occurrence of Concretionary Masses of Flint and Chert in the Maltese Limestones.

Geol. Mag., Dec. 3, vol. x. pp. 157–160.

The concretions occur in the central portion of the Globigerina Limestone, which is believed to have been deposited at greater depths than the upper and lower portions. They assume a variety of forms, and are two or more feet in length and 6–12 inches in thickness, but are sometimes spheroidal; the larger ones are of flint, the smaller of chert. The interior is often black with carbonaceous matter, and the surrounding limestone is invariably cherty. The silica is thought to be obtained by the action of organisms, and then precipitated by chemical action.

675. Elliott, G. F. S., and Raisin, Catherine A. — Colonial Reports — Miscellaneous — No 3: Sierra Leone. Reports on Botany and Geology.

London, Eyre and Spottiswoode, 8vo, pp. 78; price 5*d.*

The first author collected about 100 specimens, and the second has examined them. They appear to be all either igneous rocks, grits, or foliated rocks. There is also some decayed ferruginous rock, but little can be learned from a mere collection, except the prevalence of exposures of crystalline rock. In Part II. 100 or more rocks are named.

676. Raisin, Catherine A.—Contributions to the Geology of Africa.

Geol. Mag., Dec. 3, vol. x. pp. 436–443.

1. Rock specimens from Upper Egypt. The following rocks are described and their microscopical characters noted: (1) Crystalline rocks, as granite, gneiss, and diorite. (2) Igneous rocks, near the first cataract, as microgranite, basalt, porphyrite, augite-syenite, mica, trap, and diabase; also near the second cataract, granite, microgranite, felstone, andesite, and basalt. These are overlain by arkose and sandstone.

2. Specimens from West Africa (Sierra Leone). These include gneiss and foliated granite, and dolerite. The sedimentary rocks are grits and conglomerates, argillites, and sandstones of Nubian type. They are more fully described in No. **675**.

677. Wood, H. R.—Study of the Dykes of Hope, Idaho.

Proc. Geol. Soc., session 1892–3, p. 151.

A description was given, but is not here printed, of certain acid and basic dykes which traverse slates and quartzites along the northern shore of Lake Pend'oreille, Idaho; together with notes on the glaciation of the area.

678. Teall, J. J. H.—Volcanic Rocks from the New Hebrides.

Quart. Journ. Geol. Soc., vol. xlix. pp. 229, 230 [*see* No. **606**].

One is an augite-andesite, another is a basalt, and the third is a dolerite.

***679. Hinde, G. J.—The Microscopic Structure of some of the Organic Rocks from the New Hebrides.**

Quart. Journ. Geol. Soc., vol. xlix. pp. 230, 231.

The rock found at 1274 ft. above sea-level on Efaté is a cavernous limestone, consisting principally of *Lithothamnion* nullipore and a few Foraminifera; that from 345 ft. on Erradaka is the same, with the addition of some corals; and that from 500 ft. on Malekula is like the last. On the other hand, the rocks from low levels, as that from 3 ft. on Malekula and another at 10 ft., are claystones with *Globigerina*: in the second

these are very numerous. There is nothing in any of them which indicates deep-water.

680. Edwards, A. M.—On a Diatomaceous Earth from Guatemala, and the occurrence of Marine Diatoms in fresh water.

Journ. Quekett Micr. Club, 2, vol. ii. No. 32, pp. 202–204.

The exact place of the deposit is not known, but it is supposed to be a relic of the melting of glaciers. A list of 26 recognized diatoms is given, and some of these are marine. Another locality is reported in New Jersey, where marine diatoms occur in a bed of clay. An analysis of the diatomite is given—

Silica	76·66
Oxide of iron	3·03
Alumina	4·87
Moisture, etc.	12·18
	96·74

***681. Gresley, W. S.—Note on Anthracite Coal-Apples from Pennsylvania.**

Colliery Guardian, vol. lxv. p. 410.

Read to the American Institute of Mining Engineers. The author notes that similar concretions have been described from Australia and France. The present ones occur in the middle of the hard-coal region in the Mammoth coal. They are hard lumps like kernels, and are occasionally composite, *i.e.* a small one enclosed in a larger; they vary in size from 10½ in. down to ½ in., and are more usually flattened than spherical. They have a subconchoidal, superficially concave fracture, and are very smooth and slippery outside, and the original "grain" of the coal is not entirely lost in them, but lies parallel to their long axes; occasionally the surface shows interference tints. Analysis shows a difference between the substance of the nodule (A), and that of the ordinary coal (B)—

	A.	B.
Moisture	5·60 ...	4·00
Volatile matter ...	3·74 ...	3·29
Fixed carbon	86·66 ...	85·36
Ash	3·80 ...	6·82

They are considered not to be true nodules but to be produced by jointing. Beyond this, however, the author will not venture to explain them. Very similar formations occur in a coal-seam in New Mexico; and large portions of Cretaceous coal in Colorado show much the same features, both hard anthracite and bituminous coal being affected. The Colorado examples are probably produced by a rolling or twisting pressure.

ECONOMICS.

682. Kyle, J. J. J.—On a Vanadiferous Lignite found in the Argentine Republic, with an Analysis of the Ash.

Rep. Brit. Assoc. for 1892, pp. 676, 687.

This is a description of the vanadiferous lignite of which details are given in No. **543**, 1892. It is the richest source of vanadic compounds known to the author.

683. Anon.—The Mining Industries of Huelva.

Journ. Soc. Arts, vol. xli. pp. 874, 875.

A historical account, from a vice-consular report, of the development of the mines up to Rio Tinto times, with future prospects.

***684. Dawson, G. M.—The Mineral Wealth of British Columbia.**

Proc. Roy. Colonial Inst., vol. xxiv. pp. 238–252.

The working of gold placers on the Fraser River, in modern gravel deposits, after a time led to the discovery and working of deeper buried pre-Glacial river channels, some of which, as those of Lightning and Williams Creeks in Cariboo, proved to be extremely rich. Placer mining in British Columbia has up to this time yielded 50 million dollars worth of gold. Reef gold-mining has scarcely yet commenced, but the mining of silver is in some districts now beginning to acquire great importance. Coal-mining began early in the history of the colony. All kinds of coal from lignite to anthracite are found, but bituminous coals of Cretaceous age are those principally worked. In 1891 over 1,000,000 tons were produced.

685. Anon.—Mineral Wealth of Nicaragua.

Journ. Soc. Arts, vol. xlii. pp. 19, 20.

A general account from a consular report of the various metal-bearing districts.

686. Newton, E. W.—The Metalliferous Minerals of Australia.

Fifty-ninth Ann. Rep. Roy. Cornwall Polyt. Soc. for 1891, pp. 117–131.

A general summary of the resources of the various colonies, as far as they have been developed.

687. Anon.—The Manganese Ore Industry of Russia.

Colliery Guardian, vol. lxvi. p. 739.

Over 332,000 tons were last year (1892) taken from this country.

688. Becher, H. M.—The Gold Quartz Deposits of Pahang (Malay Peninsula).

Quart. Journ. Geol. Soc., vol. xlix. pp. 84–88.

The gold quartz formation of Pahang traverses a series of slates, schists, and quartzites, which dip at a high angle eastwards from a central granitic axis. The gold-bearing rocks are essentially quartz-veins, which may be classed as lodes and irregular formations. The lodes are also very irregular, and are most auriferous when thinnest. Rich streaks follow the walls and impregnate the country rock and the "horses." The dip is also irregular. The most lode-like veins occur in the talcose schists. With one of the richest lodes a felspar porphyry is associated, and many others are intimately connected with intrusions of igneous rock. It is amongst disintegrated masses of these igneous rocks that the irregular formations occur, as thin strings of quartz, making a kind of stockwork. It is probably from this source that most of the alluvial gold is derived.

689. Shaw, F. G.—Auriferous Conglomerates of the Witwatersrandt.

Trans. Fed. Inst. Mining Eng., vol. v. pp. 169–176.

The author considers these conglomerates, which are of wide extent and fairly uniform thickness, to be sea-beach deposits on a rising or sinking area. The matrix was originally something different, but has been replaced by silica obtained in part from underground thermal waters which also contained the gold.

690. Jeppe, F.—The Zoutpansberg Gold-Fields in the South African Republic.

The Geographical Journal, vol. ii. pp. 213–237, with a map and views.

Gives a historical account of the development, and for the geology quotes C. J. Alford [No. **545**, 1891] and A. R. Sawyer [No. **540**, 1892]. The views show some remarkable forms of rock-weathering.

***691. Gibson, W.—Geology of the Southern Transvaal.**

Trans. Fed. Inst. Mining Eng., vol. vi. pp. 124–133, plates iii., iv.

Another description of this region, abbreviated from the author's paper to the Geological Society [No. **537**, 1892]. It is considered that "the gold is of alluvial origin, and was confined to the conglomerates. Long after the tilting and moving of the beds, and probably at the time of the great igneous intrusions, a solution containing iron salts permeated

the strata"; "the original gold in the conglomerates was dissolved and redeposited, mostly in the conglomerates, but in some cases along the margin of the conglomerate bands." The plates give plans and sections across the gold-field.

***692. Penning, W. H.—Stanford's Map of the Transvaal Gold-Fields, with the Geology of the Southern part, and an accompanying Memoir.**

London, Stanford, 8vo, pp. 37, and map—scale 16 miles to an inch; price 12*s*.

The memoir is stated to contain the substance of the author's communications to the Geological Society in 1884, 1885, and 1891 [*see* No. **546**, 1891], and to the Society of Arts in 1884 and 1888.

693. Halse, E.—Note on the Antimony Deposit of El Altai, Sonora, Mexico.

Trans. Fed. Inst. Mining Eng., vol. vi. pp. 290–294.

The ore is a heavy yellow mineral called stibiconite, composed of hydrated oxide of antimony, containing 75 per cent. of metal, which has less than 1 per cent. of impurities.

694. Halse, E.—The Gold-bearing Veins of the Organor district Tolima, U.S. Columbia.

Trans. N. Eng. Min. and Mech. Eng., vol. xlii. pp. 259–275; and Trans. Fed. Inst. Mining Eng., vol. v. pp. 233–249, plates ix., x.

The gold-bearing rocks of this district are of a schistose character, and include igneous rocks. The veins are of four kinds, viz.: bedded veins, veins of rich auriferous gossan or quartz, auriferous flucany joints, and quartz fissure veins. The first three occur only in the igneous rocks, but the last is the most important. The veins run in three sets—an older E. and W., a N. and S. cross course, and a new E. and W. set. Numerous details are given about these, but the field is said to be an unimportant one at present. The plates consist of illustrative sections.

695. Halse, E.—Note on the occurrence of Mercury at Quindra, Tolima, U.S. Columbia.

Trans. Fed. Inst. Mining Eng., vol. vi. pp. 59–63, plate ii.

The cinnabar occurs here in chloritic schists of Palæozoic age, but dioritic rocks are near. The ore is indicated by red spots. It is considered to be an impregnation due to the intrusion of the diorite. A table is quoted from G. F. Becker,

showing the various cinnabar localities of the world. Of these there are 16 in Europe, 3 in Asia, 1 in Africa, 7 in North America, and 6 in South America.

696. Touzeau, E. M.—Gold-Mining in Brazil.

Trans. N. Eng. Inst. Mining Eng., vol. xlii. pp. 73–86; and Trans. Fed. Inst. Mining Eng., vol. iv. pp. 219–232, plate xiii.

Details are given of the gold-working at Minas Geraes, Jacotinga, and the Don Pedro mine. The Jacotinga formation is composed of micaceous ore, brown iron ore, saccharoid quartz, oxide of manganese, iron pyrites, iron glance, and clay; and this is said to be the only known example of such a mode of occurrence of gold.

697. Emmons, S. F.—Geological Distribution of Iron Ore in the United States.

Colliery Guardian, vol. lxvi. pp. 883, 884.

Read to the American Institute of Mining Engineers. The iron-ore deposits of the Algonkian, Cambrian, Silurian, Mesozoic, and Tertiary rocks are here described. The origin of such vast deposits of iron is then discussed, and they are considered to have an aqueous source, the deposition being in a large degree due to the metasomatic replacement of the rock material. The water came from the surface, and concentrated the iron it found dispersed through large masses of sedimentary rock. The primary source of the iron in these rocks may have been the magnetite originally formed by a differentiating process in basic eruptive magmas, such as are found associated with the Lake Superior gabbros. Magnetite is mostly found in the neighbourhood of large masses of eruptive rock.

*698. Winchell, H. V.—The Mesabi Iron-Range of Minnesota.

Colliery Guardian, vol. lxv. p. 206.

The Mesabi iron-ore beds are found only on the south side of the Giant range of granitic rocks, no trace occurring on the north. They lie on quartzite, forming part of the Taconic system, but only in places where they have a sufficient slope for drainage and concentration. In the eastern portion the hæmatite has been rendered magnetic by the overflow of the gabbro. It is, however, somewhat difficult to account for the streaks of magnetite which lie in the midst of beds of hæmatite. The author cannot admit chemical agencies, because the iron ores lie superficially, and would tend to be oxidized rather than deoxidized; but prefers to suppose that even these streaks were produced by the heat of the gabbro, where the rock was richer in iron, and that the hæmatite has been subsequently produced.

699. Anon.—The Iron Deposits of New South Wales.

Colliery Guardian, vol. lxvi. p. 370.

This is an extract from the Annual Report of the Department of Mines of New South Wales.

700. Atkinson, W.—Magnetic Iron in South Australia.

Colliery Guardian, vol. lxvi. p. 149.

An abstract of a paper read to the Australian Institute of Mining Engineers. Mount Jagged, 10 miles north of Port Victor, is composed of iron oxide. The analysis shows—Ferric oxide, 90·627; Ferrous oxide, 8·329; Titanium oxide, 0·975; Silica, 0·169 = 100·100.

701. Jamieson, M. B., and Howell, J.—Mining and Ore Treatment at Broken Hill, N.S.W.

Minutes Proc. Inst. Civil Eng., vol. cxiv. pp. 116–151.

On pp. 118–122 an account of the geology of the district is given. The country rock is a schist, traversed by a network of granite and diorite dykes. The hill is marked by masses of manganese and iron-stained rock, and on either side are broad dykes of diorite. The lode appears to be a mineralized belt without regular walls, and neither the silver nor its lead carrier appear on the surface in any quantity. The ore bodies vary from 316 ft. to 15 ft. in width, but are often split up by "horses." Manganese-iron ore forms the capping of the lode throughout, and it is beneath the iron that the greatest extent of ore is found as carbonate of lead or masses of kaolin, while below these are found enormous masses of sulphide ore extending from 110 ft. to 515 ft. in depth. Some of these are oxidized, and are then richer in silver, which is thought to have been leached out of larger masses. In an appendix five analyses are given of different varieties. The silver ranges from 7 oz. to 700 oz. per ton.

702. Power, F. D.—The Pambula Gold Deposits.

Quart. Journ. Geol. Soc., vol. xlix. pp. 233–235.

The Pambula gold-field is in the S.E. corner of New South Wales. The ore deposits consist of shattered bands of the country rock, which is a pyrophyllite schist interbedded with felspar porphyry. These shattered bands divide the district into a network, and the richest part is round the central line. East of these bands the rock is divided into lenticles, and the clay between the lenticles contains the gold associated with pyrites. The best ores yield from 1 oz. to 11 oz. per ton.

703. Anon.—The Murchison Gold-Field.

Geol. Mag., Dec. 3, vol. x. p. 288.

Notes the discovery of the gold-field in West Australia. It runs in a north and south direction about 200 miles from the coast.

704. Sowden, C.—To the Tasmanian Tin Mines.

The Nat. Hist. Journ., vol. xvii. pp. 6–8.

A description of the works at Mount Bischoff.

705. Binns, G. J.—Mining in New Zealand. Part II.: Miscellaneous Mining.

Trans. Fed. Inst. Mining Eng., vol. iv. pp. 59–82, plate vii. For Part I. *see* No. **545**, 1892.

The minerals here dealt with are:—

Antimony.—This is found in Auckland, Queen Charlotte Sound, remarkable for its stibnite, Collingwood, Brunneton, where the ore is richly auriferous and argentiferous, Otago, and many other places.

Copper.—As chalcopyrite on the Island of Kawau and Dusky Sound, and as cuprite in Nelson.

Manganese.—Various ores in Auckland.

Tin.—In stream deposits near Hokitoka on the west coast of the South Island.

Scheelite in Otago, and chromite in Nelson.

Silver in Auckland and near Collingwood; also a geocronite.

Iron.—As iron sand on the Taranaki shore, and as magnetite and limonite in Auckland and Nelson.

Sulphur.—In a pure state in White Island, off the coast of Auckland.

Graphite.—In Wellington and elsewhere, but always impure.

Petroleum.—At Taranaki, Poverty Bay, and Manutake, but in poor quantity, and in oil shale on Chatham and Auckland Islands.

Clay and sand, Building stone, and Limestone are widely distributed.

In addition to these, zinc, lead, mercury, barium, bismuth, arsenic, nickel, diatomaceous earth, asbestos, and precious stones occur in small quantities. The map shows the localities mentioned.

706. Anon.—The Coal Belt.

Colliery Guardian, vol. lxv. p. 1054.

Attention is drawn to the limitation of coal-beds in the northern hemisphere by certain latitudes, and it is suggested that this is due to a uniform dispersal of plants in an early period from a centre situated in the polar regions.

707. Breton, L.—Bas Boulonnais Coal-Measures.

Colliery Guardian, vol. lxv. pp. 667–669.

Read to the Société de l'Industrie Minerale, St. Etienne. Prof. Gosselet considers that the Bas Boulonnais Coal-measures are on the same horizon as those of the Pas de Calais, but the author does not think they could have been formed within the limits of a single basin, as there are beds in the Boulonnais coal series, *e.g.* the hæmatite and fireclay bands, which are absent in the other series, but especially the former is not found to contain anthracite, of which a long account is given, and this connects it rather with the types of the South of England than with the other coal-fields of France.

708. Oppermann, M.—The Fuveau Coal-Field of France.

Colliery Guardian, vol. lxv. pp. 1101, 1102, and 1141, 1142.

Read to the Société de l'Industrie Minerale, St. Etienne. The strata of this coal-field comprise portions of the Cretaceous and Tertiary systems, and the author follows M. Matheson in his classification of them, but divides the Vitrolian and Begudian groups into two. All the workable seams, however, are comprised in the Fuvelian, but it is not stated what part of the series this subdivision occupies. The bulk of the paper is occupied with descriptions of particular areas, the mines, and the methods of working.

709. Leproux, M.—Coal in the Caucasus.

Colliery Guardian, vol. lxv. p. 116.

Extracted from the Annales des Mines. The Kubau and Terek coal-bearings beds, some of which occur at high elevations on Mt. Elburz, belong to the Middle Jurassic Sandstones, but the coal is not more than 2 ft. thick. The Kutais beds are of Upper and Middle Jurassic age; those of the former age are thin, but those of the latter range up to 5 ft. The Daghestan beds are also Jurassic, but those of Tiflis are chiefly of Tertiary and post-Tertiary age. The analyses given show that these coals contain abundance of ash, are non-bituminous, but very rich in volatile matters.

710. Anon.—South African Coal.

Colliery Guardian, vol. lxvi. p. 604.

Extract from a report to the Government of Cape Colony, discussing the quality of native coal, which is such that it is 10 per cent. cheaper to import Welsh coal.

***711. Redmayne, R. A. S. — The Geology and Coal Deposits of Natal.**

Trans. N. of Eng. Mining and Mech. Eng., vol. xlii. pp. 221–256; and Trans. Fed. Inst. Mining Engineers, vol. iv. pp. 553–587, plates xxiii., xxiv.

The alluvial deposits consist of a raised sea-beach full of shell at the Bluff of Durban, 300 ft. above sea-level, and there are also many nodules of recently formed limestone, also bog-iron and travertine deposited by superficial waters. The Cretaceous rocks consist of greenish sands and clays, with rolled pebbles; they contain ammonites and forest trees in flint, 70 ft. long by 2 ft. in diameter, but the beds do not exceed 100 ft. in thickness, and include no igneous rocks. The Triassic system is coal-bearing, and consists of gritty sandstones and coloured shales, and has a maximum thickness of 4000 ft. It extends over a vast area, and is cut up by many dykes and igneous flows, as, for example, on the Zwart Kopf mountains, and in part of the Drakenberg. The coal is chiefly found in the Klip river country (as shown on the map), and it is agreed that Green and Galloway are right in considering it to be of drift origin. The Pietermaritzburg shales represent the Middle Trias. The Palæozoic "Boulder-clay formation" is of the same character as in Cape Colony, where it has been described by Prof. Green, whose account is quoted; the area covered by it is enormous. There are also Silurian sandstones 500 ft. in thickness, and pre-Silurian beds 1200 ft. thick.

Considerable details are then given of the coal-fields in the Biggaisberg range, the Dundee plateau, and the Newcastle district, mostly dealing with the outputs and methods of working. In 1892, 118,934 tons were raised. In an appendix the strata found in ten boreholes are recorded, and an analysis given of the Walmsley coal. A map showing the coal-fields accompanies the paper.

712. Moore, A. G.—Notes of a Mining Engineer's Visit to S. Africa.

Proc. Phil. Soc. Glasgow, vol. xxiv. pp. 190–205, plate vi.

The rocks of the coal-bearing Klip river district, 200 miles from Durban, consist in descending order of (1) basaltic trap rock; (2) Triassic horizonal Coal-measures; (3) Maritzburg shales; (4) conglomerate; (5) sandstones, probably of Silurian age; (6) Primary. They all lie very flat. There are four mining districts. The coal-seams are rather thin, and have an aggregate thickness of 5–8 ft.; they are of very good quality, partly anthracitic, and partly bituminous.

713. Robertson, R. — The Coal-Fields of Cape Breton Island.

Trans. Min. Inst. Scotland, vol. xiv. pp. 43–47.

A mining paper.

714. Patterson, Dr.—The Early History of Mining in Pictou County, Nova Scotia.

Colliery Guardian, vol. lxvi. p. 1023.

Read to the Mining Society of Canada.

715. Anon. — Notes from the British North American Coal-Fields.

Colliery Guardian, vol. lxvi. pp. 376 and 556.

Coal has been found near Grand lake, Newfoundland, and at the head of the Bay of Fundy. Analyses are given of impure anthracite in the New Brunswick Devonian, of the lignites E. and W. of the 112° meridian, and of compared samples of Appalachian and Cape Breton coal.

716. Ormiston, J. — Notes of a Visit to Vancouver Island and its Coal-Fields.

Trans. Min. Inst. Scotland, vol. xiv. pp. 150–160.

The coal strata are underlain by trap, and overlain by conglomerate.

717. Anon.—Notes on the region of Eternal Coal.

Colliery Guardian, vol. lxv. pp. 29, 66, 126, and 173.

By this name the author means the Cretaceous and Tertiary coal-fields of the North-west of British America, of which an outline account is given.

***718. Cadell, H. M.—A Visit to the Coal, Oil, and Anthracite Districts of Pennsylvania, August, 1891.**

Trans. Min. Inst. Scotland, vol. xiii. pp. 242–262, plates lxiii.–lxviii. (1892).

Gives figures showing the position of the oil, gas, and brine wells in relation to the anticlinals and synclinals, and the effects of thrusts on the structure of a coal-field as illustrated by a remarkable example of a reversed fault at Shenandoah City Colliery.

***719. Lyman, B. S.—An occurrence of coarse Conglomerate above the Mammoth Anthracite Bed.**

Colliery Guardian, vol. lxv. p. 173.

Read to the American Institute of Mining Engineers. There is a great conglomerate at the base of the Pennsylvanian Coal-measures, hence it has been laid down that beneath a conglomerate there is no coal. There is, however, a great crag of conglomerate six miles west of Tamaqua, which has been considered to be the basal conglomerate faulted up; but recent explorations have proved the Mammoth coal-seam beneath it. Several other instances of conglomerate beneath this seam are then quoted.

720. Hodge, J. M.—The Big-Stone Gap Coal-Field.

Colliery Guardian, vol. lxv. pp. 424, 425.

A reprint of a paper before the American Institute of Mining Engineers. This coal-field is in Virginia. The Stone and Pine Mountains form the sides of a trough making angles with the horizontal of 20° up to more than 90°. The rocks belong to the lower productive measures and show 20 beds of coal, separated by an average thickness of 100 ft. of strata. Above the coal beds a limestone forms crags. The highest bed of coal is an exceptionally fine splint, and others are bituminous and coking. All the principal beds are described.

721. Killebrew, J. B.—The Coal-Measures of Tennessee.

Colliery Guardian, vol. lxvi. pp. 38–42.

Extract from the American.

722. Robertson, J. R. M.—The occurrence of Torbanite or Kerosene Coal in the colony of New South Wales.

Trans. Min. Inst. Scotland, vol. xiv. pp. 88–112, plates iv.–viii.

The author commences by a general description of the New South Wales Coal-field. "The available coal resources of New South Wales are limited, and have been foolishly exaggerated." Vertical sections are given, showing the position of the kerosene shale. It occurs in lenticular deposits, mostly lying near the base of the Coal-measures. It is a mistake to suppose that a thick cover prevents the occurrence of oil shale, for some of the best lies under the thickest cover. The best occurs in Hartley Vale, of which numerous sections are drawn and described. Streaks of jet here occur in it. Under the microscope the sections have a reticulated appearance, with brown translucent areas. The following analysis is given:—

Volatile hydrocarbons	83·87
Fixed carbon	8·03
Ash	7·07
Sulphur	·58
Moisture	·44
	99·99

It yields 150–160 gallons of oil, and 20,000 cubic feet of gas per ton.

723. Lamb, E. de V.—Notes on the Coal-Field of New South Wales.

Proc. South Wales Inst. Eng., vol. xviii. pp. 48–114, pls. ii.–xi.

The author gives a general account of the history and present development of the three coal-fields of this country in the order of their importance. These are: (1) The Northern, or Newcastle. (2) The South and South-Western, or Illawarra. (3) The Western, or Lithgow Valley.

724. Robertson, J. R. M.—The Coal-Fields South of Sydney, New South Wales.

Trans. Fed. Inst. Min. Eng., vol. iv. pp. 83–109, pls. viii., ix.

This paper gives further details about the Illawarra coal-field. The author considers that any estimate of quantity founded on the actual area of the Coal-measures is misleading, as they are mostly covered by the Hawkesbury Sandstone, a formation peculiar to Australia. There are no real evidences of glaciation during the coal-producing epoch; the boulders found may all be current-borne. The Coal-measures may be of Triassic age, and there are no points of similarity between them and the Coal-measures of Europe.

725. Dawkins, W. B.—The Coal-Fields of New South Wales.

Trans. Manchester Geol. Soc., vol. xxii. pp. 160–169, plate and sections.

A general description.

726. Durand, M.—Geology and Useful Minerals of Meurthe et Moselle, France.

Colliery Guardian, vol. lxvi. pp. 497, 498.

The formations briefly described are the Vosgian Sandstone, the Triassic, and Jurassic. The minerals are iron ore, the finest in France, belonging to the Lias and Lower Oolite; rock salt in the Trias marls; Jurassic building-stones; gypsum in the Trias marls; and phosphatic nodules in the Lower Lias.

727.—Anon.—Production of Precious Stones in Siberia.

Journ. Soc. of Arts, vol. xlii. p. 58.

Precious stones are most abundant in the Trans-Baikal region. Lapis Lazuli occurs in the Baikal Mountains. On a

tributary to the Iskert it forms pockets in the limestone near its junction with syenitic granite. In the valley of the Uluntui dark mica 2 ft. in diameter occurs. Pebbles of nephrite are found on a tributary of the Angara 30 miles below Irkutsk.

728. Dawson, Sir J. W.—Notes on Useful and Ornamental Stones of Ancient Egypt.

Journ. Trans. Victoria Inst., vol. xxvi. pp. 265–282.

Published separately in 1891. [*See* No. **618**, 1891.]

729. Small, H. B.—The Phosphate Mines of Canada.

Colliery Guardian, vol. lxv. p. 550.

Read to the American Institute of Mining Engineers. A general account.

730. Anon.—Production of Mica in the United States.

Journ. Soc. Arts, vol. xli. pp. 596, 597.

Describes the mines and workings in western North Carolina. One piece of mica from Wiseman mine is reported as 6 ft. by 3 ft.

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